



SITE-SPECIFIC HEALTH AND SAFETY PLAN

**20 JEFFERSON AVENUE
ELGIN, ILLINOIS**

**Prepared For:
Jefferson Yard Removal Action Group**

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TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
1.1 PURPOSE.....	1
1.2 STOP WORK AUTHORITY	1
1.3 PERSONNEL REQUIREMENTS.....	2
1.4 PROJECT MANAGEMENT AND SAFETY RESPONSIBILITIES	2
1.5 TRAINING REQUIREMENTS.....	4
1.5.1 SITE SPECIFIC TRAINING	4
1.5.2 SAFETY MEETING/HEALTH AND SAFETY PLAN REVIEW	5
2.0 SITE OPERATIONS	6
2.1 SITE HISTORY/BACKGROUND	6
2.2 SCOPE OF WORK.....	6
3.0 HAZARD EVALUATION	7
3.1 CHEMICAL HAZARDS.....	7
3.1.1 CHEMICAL HAZARD CONTROLS.....	7
3.1.2 SKIN CONTACT AND ABSORPTION CONTAMINANTS.....	8
3.1.3 FLAMMABLE AND COMBUSTIBLE LIQUIDS.....	8
3.2 PHYSICAL HAZARDS.....	9
3.2.1 HEAVY EQUIPMENT SAFETY	10
3.2.2 NOISE.....	11
3.2.3 UTILITY CLEARANCES.....	11
3.2.4 MATERIAL HANDLING AND STORAGE	11
3.2.5 MANUAL LIFTING.....	13
3.2.6 HAND AND POWER TOOLS.....	14
3.2.7 EXCAVATIONS.....	15
3.2.8 COMPRESSED GAS CYLINDERS.....	17
3.2.9 SLIP/TRIP/HIT/FALL	18
3.2.10 HEAT STRESS.....	19
3.2.11 COLD STRESS.....	20
3.2.12 ADVERSE WEATHER CONDITIONS.....	22
3.2.13 SPECIAL WORK CONDITIONS/SITUATIONS.....	23
3.3 BIOLOGICAL HAZARDS.....	23
3.3.1 VEGETATION OVERGROWTH.....	23
3.3.2 POISONOUS PLANTS	24
3.3.3 INSECTS	25
3.3.4 POISONOUS SPIDERS.....	28
3.3.5 THREATENING DOGS.....	29
3.3.6 SNAKES.....	29
3.3.7 BLOODBORNE PATHOGENS	31
4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE).....	32
4.1 GENERAL	32
4.2 TYPES OF PERSONAL PROTECTIVE EQUIPMENT (PPE).....	32

TABLE OF CONTENTS (CONT'D)

	<u>Page</u>
4.2.1	TYPES OF PROTECTIVE MATERIAL32
4.3	RESPIRATORY PROTECTION33
4.3.1	RESPIRATOR CLEANING34
4.4	LEVELS OF PROTECTION.....34
4.4.1	REASSESSMENT OF PROTECTION LEVELS.....34
5.0	AIR MONITORING PROGRAM.....36
5.1	EXPOSURE MONITORING36
5.1.1	DUST MONITORS36
5.1.2	MONITORING FREQUENCY.....36
5.1.3	HEALTH AND SAFETY ACTION LEVELS.....37
6.0	SITE CONTROL38
6.1	COMMUNICATION39
6.2	BUDDY SYSTEM.....39
6.2.1	RESPONSIBILITIES39
6.3	SITE SECURITY40
6.4	DECONTAMINATION.....40
6.4.1	PERSONNEL AND EQUIPMENT DECONTAMINATION PROCEDURES.....40
7.0	EMERGENCY PROCEDURES.....42
7.1	ON-SITE EMERGENCIES42
7.2	ACCIDENT, INJURY, AND ILLNESS REPORTING AND INVESTIGATION.....42
7.3	EMERGENCY EQUIPMENT/FIRST AID43
7.4	EMERGENCY PROCEDURES FOR CONTAMINATED PERSONNEL.....44
7.5	SITE EVACUATION44
7.6	SPILL AND RELEASE CONTINGENCIES45
8.0	RECORDKEEPING.....46

LIST OF TABLES

TABLE 1	PROPERTIES OF POTENTIAL SITE CONTAMINANTS
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LIST OF APPENDICES

APPENDIX A	FORMS
APPENDIX B	JOB SAFETY ANALYSIS TABLES
APPENDIX C	MATERIAL SAFETY DATA SHEETS
APPENDIX D	EXCAVATION SAFETY PROGRAM

Health and Safety Plan Signature Page

Site Name: Jefferson Yard

Location address: 20 Jefferson Avenue, Elgin, Illinois

Ref. No. 054633 CRA Office: Saint Paul

Anticipated Start Date: _____ Anticipated Project Duration: _____

Prepared By (Signature): _____ Date: _____

Project Manager (Signature): _____ Date: _____

Reviewed By (Signature):  Date: 2/23/09

This signature page must be completed and be available on site for review. This page does not however replace the QSF-016 requirements.

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this site-specific health and safety plan (HASP) is to provide specific guidelines and establish procedures for the protection of personnel performing the activities described in Section 2.0 – Site Operations. The information in this HASP has been developed in accordance with applicable standards and is, to the extent possible, based on information available to date. The HASP is also living document in that it must continually evolve as site conditions and knowledge of the site work activities develop.

A vital element of CRA's Health and Safety Policies and Procedures is the implementation of a site-specific HASP for field activities. This HASP, as applicable to this project, includes the following measures:

- Communicate the contents of this HASP to site personnel.
- Eliminate unsafe conditions. Efforts must be initiated to identify conditions that can contribute to an accident and to remove exposure to these conditions.
- Reduce unsafe acts. Personnel shall make a conscious effort to work safely. A high degree of safety awareness must be maintained so that safety factors involved in a task become an integral part of the task.
- Inspect frequently. Regular safety inspections of the work site, materials, and equipment by qualified persons ensure early detection of unsafe conditions. Safety and health deficiencies shall be corrected as soon as possible, or project activities shall be suspended. Documentation of daily inspections and corrective actions should be kept with the project files.

1.2 STOP WORK AUTHORITY

All CRA employees are empowered and expected to stop the work of co-workers, subcontractors, client employees, or other contractors if any person's safety or the environment are at risk. NO repercussions will result from this action.

The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated shall result in the removal of site personnel from that area and reevaluation of the hazard and the levels of protection.

1.3 PERSONNEL REQUIREMENTS

All personnel conducting activities on site must conduct their activities in compliance with all applicable Safety and Health legislation throughout North America to include, but not limited to, the Occupational Safety and Health Administration (OSHA) 29 CFR 1910, 29 CFR 1926, and CRA policies and procedures. **Project personnel must also be familiar with the procedures and requirements of this HASP.** In the event of conflicting safety procedures/ requirements, personnel must implement those safety practices which afford the highest level of safety and protection.

Employees identified as CRA Short Service Employees (6 months or less) shall not be permitted to work without another non-short service CRA employee present.

1.4 PROJECT MANAGEMENT AND SAFETY RESPONSIBILITIES

Project Manager – CRA- Ron Frehner

The CRA Project Manager (PM) shall be responsible for the overall implementation of the HASP, and for ensuring that all health and safety responsibilities are carried out in conjunction with this project. This shall include, but is not limited to, review and approval of the HASP. The PM will also ensure the appropriate resources are provided to support the project with respect to all operations.

Site Supervisor – CRA- To Be Determined

The Site Supervisor (SS) is the person who, under the supervision of the project manager, shall be responsible for the communication of the site requirements to site project personnel and subcontractors, and is responsible for carrying out the health and safety responsibilities by making sure that:

1. All necessary cleanup and maintenance of safety equipment is conducted by project personnel.
2. Emergency phone numbers/services including hospital/clinic locations are verified/contacted.
3. Forms attached to the HASP are completed, filed, and submitted correctly.
4. A pre-entry briefing is conducted and documented, which will serve to familiarize on-site personnel with the procedures, requirements, and provisions of this HASP.

Other duties include overall implementation of the HASP, and ensuring all health and safety responsibilities are carried out in conjunction with this project. This shall include, but is not limited to, review and approval of the HASP, communication of site requirements to subcontractor personnel, and consultation with the client/site representative regarding appropriate changes to the HASP.

The SS also has the responsibility of enforcing safe work practices for project employees. The SS watches for any ill affects on any crew member, especially those symptoms caused by cold/heat stress or chemical exposure. The SS oversees the safety of any visitors who enter the site. The SS maintains communication with the client/site representative(s).

Other specific duties of the SS include:

- Orders the immediate shutdown and/or stopwork of site activities in the case of a medical emergency, unsafe condition or unsafe practice.
- Provides the safety equipment, personal protective equipment (PPE), and other items necessary for employees.
- Enforces the use of required safety equipment, PPE, and other items necessary for employee or community safety.
- Conducts job site inspections as a part of quality assurance for safety and health.
- Reports safety and health concerns to site and/or project management as necessary.

Regional Safety & Health Manager - CRA - William Doyle

The Regional Safety & Health Manager (RSHM) is a full-time CRA employee who is trained as a health and safety professional, who serves in a consulting role to the PM, Safety and Health Officer (SHO), and SS regarding potential health and safety issues.

Employee Safety Responsibility

CRA employees are responsible for their own safety as well as the safety of those around them. CRA employees shall use any equipment provided in a safe and responsible manner, as directed by their supervisor.

Employees are directed to take the following actions when appropriate:

- Suspend any operations which may cause an imminent health hazard to employees, subcontractors, or others.

- Correct job site hazards when possible to do so without endangering life or health.
- Report safety and health concerns to the SS, PM, or RSHM.

Subcontractors - CRA subcontractors are responsible for the implementation of their HASP and agree to comply with its contents. In the event of conflicting safety procedures/requirements, personnel must implement those safety practices, which afford the highest level of safety and protection. In addition, it is also understood that non-compliance with health and safety policies and procedures may subject the subcontractor to disciplinary action up to and including termination of their contract with CRA. Subcontractors will be required to attend an initial site orientation and attend subsequent safety meetings.

Equipment Operators - All equipment operators are responsible for the safe operation of heavy equipment. Operators are responsible for inspecting their equipment on a daily basis to ensure safe performance. Brakes, hydraulic lines, backup alarms, and fire extinguishers must be inspected routinely throughout the project. Equipment will be taken out of service if an unsafe condition occurs.

Authorized Visitors - Shall be provided with all known information with respect to the site operations and hazards as applicable to the purpose of their visit.

1.5 **TRAINING REQUIREMENTS**

All personnel conducting work at this site shall have completed the appropriate health and safety training as applicable to their job tasks/duties. The required training is referenced throughout the HASP and identified on each job safety analysis sheet.

1.5.1 **SITE SPECIFIC TRAINING**

An initial site-specific training session or briefing shall be conducted by the PM or SS prior to commencement of work activities. During this initial training session, employees shall be instructed on the following topics:

- personnel responsibilities;
- content and implementation of the HASP;
- site hazards and controls;
- site-specific hazardous procedures (e.g., drilling, etc.);

- training requirements;
- PPE requirements;
- emergency information, including local emergency response team phone numbers, route to nearest hospital, accident reporting procedures, and emergency response procedures;
- instruction in the completion of required inspections and forms; and
- location of safety equipment (e.g., portable eyewash, first aid kit, fire extinguishers, etc.).

The various components of the project HASP will be presented followed by an opportunity to ask questions to ensure that each attendee understands the HASP. Personnel will not be permitted to enter or work in potentially contaminated areas of the site until they have completed the site-specific training session. Personnel successfully completing this training session shall sign the HASP Training Acknowledgement Form, which is presented in Appendix A.

In addition to the initial site briefing conducted at the commencement of the project, supplemental brief safety meetings shall be conducted by the SS to discuss potential health and safety hazards associated with upcoming tasks and necessary precautions to be taken.

1.5.2 SAFETY MEETING/HEALTH AND SAFETY PLAN REVIEW

"Tailgate" safety meetings will take place each day prior to beginning the day's work. All site personnel will attend these safety meetings conducted by the SS. The safety meetings will cover specific health and safety issues, site activities, changes in site conditions, and a review of topics covered in the site-specific pre-entry briefing. The safety meetings will be documented with written sign-in sheets containing a list of topics discussed. This form is found in Appendix A.

2.0 SITE OPERATIONS

2.1 SITE HISTORY/BACKGROUND

The Jefferson Yard is approximately 1.3 acres in area and formerly was a non-ferrous scrap yard. In 1995, a removal action was conducted and 2,600 CY of contaminated soil was removed from the open area of the yard. Clean backfill was placed and compacted in the excavation area. After 1995, scrap yard operations continued until 2003 or 2004.

The Jefferson Yard was purchased by the City of Elgin in 2004 with plans to develop the property for residential or recreational use.

In November of 2008, CRA conducted soil sampling to further delineate the quantity of soil above remediation levels.

2.2 SCOPE OF WORK

The objectives of this project are to *remediate or remove contaminated soil to below USEPA's remedial objectives*.

This HASP covers the specific site activities that will be conducted by CRA personnel and their subcontractors. These activities are as follows:

- mobilization of personnel, materials, and equipment to and from the site;
- clean concrete pad;
- debris removal activities;
- In-situ stabilization activities;
- excavate and dispose of contaminated soil;
- backfill with clean fill; and
- decontamination of personnel and equipment.

If site operations are altered or if additional tasks are assigned, an addendum to this HASP shall be developed to address the specific hazards associated with these changes. All addendum are to be developed in conjunction with project management and a CRA safety professional.

3.0 HAZARD EVALUATION

This section identifies and evaluates the potential chemical, physical, and biological hazards, which may be encountered during the completion of this project. Specific activity job safety analysis (JSA) tables (located in Appendix B) have been developed to address the hazards associated with the site operations outlined in Section 2.0.

3.1 CHEMICAL HAZARDS

The chemical hazards associated with conducting site operations include the potential exposure to on-site contaminants encountered during field activities such as *clean concrete pad, remove debris, in-situ stabilization, excavate and dispose of contaminated soil, and backfill with clean fill*, products used in decontamination of equipment, and support products such as fuel. The potential routes of exposure from these products during normal use may occur through inhalation of vapors/dusts or direct contact or absorption with the materials. The chemical hazards of concern that may be encountered during the tasks identified in the project's scope of work include *lead, PCBs, and dioxins*. A listing of the contaminants of concern are found in Table 1, which includes exposure limits, signs, and symptoms of exposure, chemical properties and physical characteristics.

3.1.1 CHEMICAL HAZARD CONTROLS

Exposure to potential on-site contaminants/chemicals, such as those listed in Table 1 and Appendix C – MSDSs, shall be controlled by:

- Monitoring air concentrations for volatile organic vapors shall be conducted in the breathing zone.
- Dust control measures, such as wetting the immediate area, shall be employed.
- Using PPE/respiratory protection as appropriate, in areas known to have concentrations above the specified action level for each contaminant.
- Contact RSHM for additional information.

3.1.2 SKIN CONTACT AND ABSORPTION CONTAMINANTS

Skin contact with chemicals may be controlled by use of the proper PPE and good housekeeping procedures. The proper PPE (e.g., Tyvek, gloves) as described in Section 4.0 shall be worn for all activities where contact with potentially harmful media or materials is anticipated. Utilize manufacturer data on permeation and degradation to minimize skin contact potential (see Section 4.2.1 for additional information).

3.1.3 FLAMMABLE AND COMBUSTIBLE LIQUIDS

The storage, dispensing, and handling of flammable and combustible liquids must be in accordance with industry standards such as National Fire Protection Agency (NFPA) guidelines. The specific flammable or combustible liquids used at the site may include gasoline, diesel, kerosene, oils, and solvents.

Flammable and combustible liquids are classified according to flash point. This is the temperature at which the liquid gives off sufficient vapors to readily ignite. Flammable liquids have flash points below 100°F (37.8°C). Combustible liquids have flash points above 100°F (37.8°C) and below 200°F (93.3°C).

Storage

Many flammables can ignite at temperatures at or below room temperature. They are far more dangerous than combustibles when they are heated. As a result, these products must be handled very carefully. At normal temperatures, these liquids can release vapors that are explosive and hazardous to employee health. Exposure to heat can cause some of these liquids to break down into acids, corrosives, or toxic gases. For this reason, flammable/combustible liquids should be stored in cool, well ventilated areas away from any source of ignition. Always consult the MSDS of the product for specific information.

Flammable and combustible liquids must be stored in designated areas. Such areas must be isolated from equipment and work activity, which may produce flames, sparks, heat or any form of ignition, including smoking. The most practical method is the use of one or more approved (commercially available) flammable/combustible liquid storage cabinets.

Cabinets must be labeled "Flammable – Keep Fire Away". Doors must be kept closed and labeled accordingly. Containers must be kept in the cabinet when not in use.

General Requirements

- Keep containers of flammable/combustible liquids closed when not in use.
- Keep flammable/combustible liquids in designated areas and approved cabinets.
- Do not allow use of unapproved containers for transfer or storage. Use only approved safety cans (5-gallon maximum) with a spring closing lid and spout cover, designated to safely relieve internal pressure when exposed to heat or fire.
- Use only approved self-closing spigots, faucets, and manual pumps when drawing flammable/combustible liquids from larger containers/barrels.
- Use only approved metal waste cans with lids for disposal of shop towels/oily rags.
- Designate "Smoking" and "No Smoking" areas.
- Designate fueling areas.
- Observe all signs indicating "No Smoking," "No Flames," "No Ignition."

Transferring Flammable/Combustible Liquids

- This seemingly routine task can be hazardous if certain precautions are not followed. Grounding and bonding must be observed at all times to prevent the accumulation of static electricity when transferring containers/barrels one to another.
- Drums should be grounded (#4 copper conductor) to a grounding rod.
- Bonding is necessary between conductive containers (e.g., a barrel and a 5-gallon container).

3.2 PHYSICAL HAZARDS

Physical hazards that may be present during project work include: close proximity to heavy equipment, noise, overhead or under ground utilities, material handling, heavy lifting, excavations, use of hand and power tools, slip/trip/hit/fall injuries, heat stress/cold stress, biological hazards, and potential adverse weather conditions. In addition, personnel must be aware that the protective equipment worn may limit dexterity and visibility and may increase the difficulty of performing some tasks.

3.2.1 HEAVY EQUIPMENT SAFETY

Heavy Equipment

The following practices shall be adhered to by personnel operating heavy equipment (such as backhoes) and personnel working in the vicinity of heavy equipment:

- Heavy equipment is to be inspected when equipment is initially mobilized/delivered to a job site or after it is repaired and returned to service to ensure that it meets all manufacturer and OSHA specifications (e.g., fire extinguishers, backup alarms, etc.).
- Heavy equipment is to be inspected on a daily basis. Documentation of this daily pre-operational inspection is to be filed with the project files.
- Heavy equipment is only to be operated by authorized, competent operators.
- Seat belts are to be provided on heavy equipment that is not designed for stand-up operation.
- Equipment/vehicles whose payload is loaded by crane, excavator, loader, etc. will have a cab shield and/or canopy to protect the operator.
- Personnel will not be raised/lowered in buckets.
- Personnel will not ride on fender steps or any place outside the cab.
- Before leaving the equipment controls, ensure that the equipment is in its safe resting position. For a backhoe, apply the parking brake, put the front loader bucket down on the ground level, and ensure that the rear excavator bucket is locked in the travel position. Bulldozers and scraper blades, loader buckets, dump bodies, and similar equipment will be fully lowered or blocked when not in use.
- Before raising any booms, buckets, etc., check for overhead obstructions.
- Employees involved in the operation shall not wear any loose-fitting clothing, which has the potential to be caught in moving machinery.
- Personnel shall wear high visibility safety vests, steel-toed shoes, safety glasses, hearing protection, and hard hats during heavy equipment operations.
- When moving heavy equipment or when working in tight quarters, a spotter should be used.

3.2.2 NOISE

Project activities that include working in close proximity to heavy equipment operations, or using power tools, that generate noise levels exceeding the decibel range of 85 dBA will require the use of hearing protection with a Noise Reduction Rating (NRR) of at least 20. Hearing protection (earplugs/muffs) will be available to personnel and visitors that would require entry into these areas.

When it is difficult to hear a coworker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to high noise levels will participate in CRA's Hearing Conservation Program.

3.2.3 UTILITY CLEARANCES

Elevated superstructures (e.g., drill rigs, back hoes, scaffolding, ladders, cranes) shall remain a distance of 10 feet away from utility lines (<50 kV) and 20 feet away from power lines (>50 kV). Underground utilities, if present, shall be clearly marked and identified prior to commencement of work. Follow local/state/provincial regulations with regards to utility locating requirements (e.g., One-Call, etc.).

Personnel involved in intrusive work shall:

- Review and adhere to CRA's Subsurface Utility Clearance Protocol.
- Utilize the Property Access/Utility Clearance Data Sheet (QSF-019).
- Be able to determine the minimum distance from marked utilities which work can be conducted with the assistance of the locator line service.

3.2.4 MATERIAL HANDLING AND STORAGE

Material handling and storage practices to be conducted at the project site include manual lifting of materials and possibly the use of hoisting and rigging equipment. As a rule, use mechanical means for lifting heavy loads whenever possible.

General Storage Practices

The basic safety requirement for storage areas is that the storage of materials and supplies shall not create a hazard. Additional general storage area practices include the following:

- Bags, containers, bundles, etc. stored in tiers shall be stacked, blocked, interlocked, and limited in height so that they are stable and secure against sliding or collapse.
- All stacked materials, cargo, etc. shall be examined for sharp edges, protrusions, signs of damage, or other factors likely to cause injury to persons handling these objects. Defects should be corrected as they are detected.
- Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest haborage.
- Storage areas shall have provisions to minimize manual lifting and carrying. Aisles and passageways shall provide for the movement of mechanical lifting and conveyance devices.
- Stored materials shall not block or obstruct access to emergency exits, fire extinguishers, alarm boxes, first aid equipment, lights, electrical control panels, or other control boxes.
- "NO SMOKING" signs shall be conspicuously posted, as needed, in areas where combustible or flammable materials are stored and handled.

Cylindrical materials such as pipes and poles shall be stored in racks, or stacked on the ground and blocked.

Special Precautions for Hazardous or Incompatible Materials Storage

Generally, materials are considered hazardous if they are ignitable, corrosive, reactive, or toxic. Manufacturers and suppliers of these materials must provide the recipient with MSDSs, which describe their hazardous characteristics and give instructions for their safe handling and storage.

Many hazardous materials are incompatible, which means they form mixtures that may have hazardous characteristics not described on the individual MSDSs. The following special precautions shall be followed regarding the storage of hazardous materials:

- Based on the information available on the MSDSs, incompatible materials shall be kept in separate storage areas.

- Warning signs shall be conspicuously posted, as needed, in areas where hazardous materials are stored.

Hoisting and Rigging

Wire ropes, chains, ropes, and other rigging equipment will be inspected prior to each use and as necessary during use to assure their safety. Defective rigging equipment will be immediately removed from service.

Rigging will not be used unless the weight of the load falls within the rigging's safe work operating range. This must be verified by the authorized rigger prior to any "pick" or lifting operation.

Only personnel trained in safe rigging procedures will be authorized to engage in rigging procedures. Additionally, the rigger must understand and use recognized crane signals.

Job or shop hooks and links and other makeshift fasteners **will not** be used. When U-bolts are used for eye splices, the U-bolt will be applied so the "U" section is in contact with the dead end of the rope.

Wire ropes, chains, ropes, and other rigging equipment will be stored where they will remain clean, dry, and protected from the weather and corrosive fumes.

The proper length of rope or chain slings will be used to avoid wide-angle lifts and dangerous slack. Knotted ropes or lengths of ropes reduced by bolts, knots, or other keepers will not be used.

3.2.5 MANUAL LIFTING

When lifting objects, use the following proper lifting techniques:

- Feet must be parted, with one foot alongside the object being lifted and one foot behind. When the feet are comfortably spread, a more stable lift can occur and the rear foot is in a better position for the upward thrust of the lift.
- Use the squat position and keep the back straight - but remember that straight does not mean vertical. A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the guts that can cause a hernia.

- Grip is one of the most important elements of correct lifting. The fingers and the hand are extended around the object you're going to lift - using the full palm. Fingers have very little power - use the strength of your entire hand.
- The load must be drawn close, and the arms and elbows must be tucked into the side of the body. Holding the arms away from the body increases the strain on the arms and elbows. Keeping the arms tucked in helps keep the body weight centered.

The body must be positioned so that the weight of the body is centered over the feet. This provides a more powerful line of thrust and also ensures better balance. Start the lift with a thrust of the rear foot. Do not twist.

3.2.6 HAND AND POWER TOOLS

Hand Tools

- Hand tools must meet the manufacturer's safety standards.
- Hand tools must not be altered in any way.
- At a minimum, eye protection must be used when working with hand tools.
- Wrenches (including adjustable, pipe, end, and socket wrenches) must not be used when jaws are sprung to the point that slippage occurs.
- Impact tools (such as drift pins, wedges, and chisels) must be kept free of mushroom heads.
- Wooden handles must be free of splinters or cracks and secured tightly to the tool.

Power Tools

- All power tools must be inspected regularly and used in accordance with the manufacturer's instructions and the tool's capabilities.
- Electric tools must not be used in areas subject to fire or explosion hazards, unless they are approved for that purpose.
- Portable electric tools must be connected to a Ground Fault Circuit Interrupter (GFCI) when working in wet areas.
- Proper eye protection must be used when working with power tools.
- Personnel must be trained in the proper use of each specific tool.
- Any damaged or defective power tools must be immediately tagged and removed from service.

3.2.7 EXCAVATIONS

All CRA excavation and trenching operations, for which employees shall enter, will be observed by a designated competent person. The competent person shall be responsible for evaluating and inspecting excavation and trenching operations to prevent possible cave-in and entrapment, and to avoid other hazards presented by excavation activities.

Each employee in an excavation shall be protected from cave-ins by one of three systems:

- Sloping and benching systems.
- Shoring.
- Shielding systems.

All excavation and trenching operations shall be conducted in accordance to and in compliance with OSHA's Standards for the Construction Industry; specifically, outlined in CRA's SOP for excavation and trenching activities (Appendix D). At a minimum, the following safety guidelines shall be adhered to while conducting excavation and trenching activities:

- Excavation and trenching operations require pre-planning to determine whether sloping or shoring systems are required, and to develop appropriate designs for such systems. Also, the estimated location of all underground installations must be determined before digging/drilling begins. Necessary clearances must be observed.
- If there are any nearby buildings, walls, sidewalks, trees, or roads that may be threatened or undermined by the excavation, where the stability of any of these items may be endangered by the excavation, they must be removed or supported by adequate shoring, bracing, or underpinning.
- Excavations may not go below the base of footings, foundations, or retaining walls unless they are adequately supported or a person who is registered as a Professional Engineer (PE) has determined that they will not be affected by the soil removal. Civil engineers or those with licenses in a related discipline and experience should be consulted in the design and use of slopping and shoring systems. PE qualifications must be documented in writing.

Access and Egress

Personnel access and egress from trench and/or excavations are as follows:

- A stairway, ladder, ramp, or other means of egress must be provided in trenches greater than 4 feet deep and for every 25 feet of lateral travel.
- All ladders shall extend 3 feet above the top of the excavation.
- Structural ramps used for access or egress of equipment will be designed by a competent person, qualified in structural design or by a licensed professional engineer.

Atmosphere Monitoring and Testing

There are three parameters by which air quality is measured: 1) oxygen concentration, 2) flammability, and 3) the presence of hazardous substances.

Employees should not be exposed to atmospheres containing less than 19.5 percent oxygen, or having a lower flammable limit greater than 10 percent, and employees should not be exposed to hazardous levels of atmospheric contaminants.

Whenever potentially hazardous atmospheres are suspected in excavations and trenches, the atmosphere shall be tested by a competent person. Detector tubes, gas monitors, and explosion meters are examples of monitoring equipment that may be used.

In the event that an unusual odor or liquid is suspected in excavations and trenches, the competent person shall stop work on the site and arrange for air quality assessment and mitigation, if necessary.

Atmospheric testing and monitoring shall be performed in excavations in or adjacent to landfill areas, in areas where hazardous materials are/were stored, or in areas where the presence of hazardous materials is suspected.

Daily Inspections

The competent person shall perform daily inspections of excavations, the adjacent areas, and all protective systems for situations that could potentially result in slope failure.

Additionally, the competent person shall be aware of the potential for confined space situations and other hazardous work conditions.

The competent person shall inspect, evaluate, and complete the excavation checklist at the following intervals:

- Prior to the start of work, after each extended halt in work, and as needed throughout the shift as new sections of the excavation or trench are opened.
- After every rainstorm and other natural or man-made event that may increase the load on the walls of the excavation, or otherwise affect their stability.

The inspections shall be documented using the CRA Excavation Inspection Checklist attached to this HASP.

The competent person shall stop the work and instruct all employees to leave the excavation or trench when any potential hazards are detected. The competent person has the authority to immediately suspend work if any unsafe condition is detected.

3.2.8 COMPRESSED GAS CYLINDERS

Compressed gases present several hazards. The cylinder must be properly labeled, identifying the hazardous properties of the gas, such as toxicity, flammability, or if it is an oxidizer, and a MSDS must be supplied by the manufacturer. In addition to the gas hazards, compressed gas cylinders pose other hazards simply because they contain gas under pressure.

Regardless of the properties of the gas, any gas under pressure can explode if the cylinder is improperly stored or handled. Improperly releasing the gas from a compressed gas cylinder is extremely dangerous. A sudden release of the gas can cause a cylinder to become a missile-like projectile, destroying everything in its path. Cylinders have been known to penetrate concrete-block walls. To prevent such a dangerous situation, there are several general procedures to follow for the safe storage and handling of a compressed gas cylinder:

- Store cylinders in an area specifically designated for that purpose. This area must protect the cylinders from being struck by another object. The area must be well-ventilated and away from sources of heat. It must be at least 20 feet away from highly combustible materials. Oxidizers must be stored at least 20 feet away from flammable gases.

- Cylinders must not be dropped or allowed to fall. Chain and rack them in an upright position during use and storage. When transporting cylinders, they must be secured from falling.
- When moving a cylinder, even for a short distance, all the valves must be closed, the regulator removed, and the valve cap installed. Never use the valve cap to lift a cylinder. If you are using a crane or some other lifting device to move a cylinder, use a cradle or boat designed for that purpose. Never use a sling or a magnet to move a cylinder.
- Never permit cylinders to contact live electrical equipment or grounding cables.
- Cylinders must be protected from the sun's direct rays, especially in high-temperature climates. Cylinders must also be protected from ice and snow accumulation.
- Before the gas is used, install the proper pressure-reducing regulator on the valve. After installation, verify the regulator is working, that all gauges are operating correctly, and that all connections are tight to ensure that there are no leaks. When you are ready to use the gas, open the valve with your hands. Never use a wrench or other tool. If you cannot open it with your hands, do not use it.

3.2.9 SLIP/TRIP/HIT/FALL

Slip/trip/hit/fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but can be minimized by the following prudent practices:

- Spot check the work area to identify hazards.
- Establish and utilize a pathway which is most free of slip and trip hazards.
- Beware of trip hazards such as wet floors, slippery floors, and uneven surfaces or terrain.
- Carry only loads which you can see over.
- Keep work areas clean and free of clutter, especially in storage rooms and walkways.
- Communicate hazards to on-site personnel.
- Secure all loose clothing and ties, and remove jewelry while around machinery.
- Report and/or remove hazards.
- Keep a safe buffer zone between workers using equipment and tools.

3.2.10 HEAT STRESS

Recognition and Symptoms

Temperature stress is one of the most common illnesses that project personnel face when working during periods when temperatures and/or humidity are elevated. Acclimatization and frequent rest periods must be established for conducting activities where temperature stress may occur. Below are listed signs and symptoms of heat stress. Personnel should follow appropriate guidelines if any personnel exhibit these symptoms:

Heat Rash	Redness of skin. Frequent rest and change of clothing.
Heat Cramps	Painful muscle spasms in hands, feet, and/or abdomen. Administer lightly salted water by mouth, unless there are medical restrictions.
Heat Exhaustion	Clammy, moist, pale skin, along with dizziness, nausea, rapid pulse, fainting. Remove to cooler area and administer fluids.
Heat Stroke	Hot dry skin; red, spotted or bluish; high body temperature of 104°F; mental confusion; loss of consciousness; convulsions or coma. Immediately cool victim by immersion in cool water. Wrap with wet sheet while fanning, sponge with cool liquid while fanning; treat for shock. DO NOT DELAY TREATMENT. COOL BODY WHILE AWAITING AMBULANCE.

Work Practices

The following procedures will be carried out to reduce heat stress:

- Heat stress monitoring.
- Acclimatization.
- Work/rest regimes (schedule of breaks) – mandatory breaks scheduled in summer months or during high risk activities for heat stress.
- Heat stress safety personal protective equipment (cool-vests, bandanas, etc.).
- Liquids that replace electrolytes, water, and salty foods available during rest.
- Use of buddy system.

Acclimatization

The level of heat stress at which excessive heat strain will result depends on the heat tolerance capabilities of the worker. Each worker has an upper limit for heat stress

beyond which the resulting heat strain can cause the worker to become a heat casualty. In most workers, appropriate repeated exposure to elevated heat stress causes a series of physiologic adaptations called acclimatization, whereby the body becomes more efficient in coping with the heat stress. Work/rest regimes planned as a component of project preparation and discussed during the daily tailgate safety meetings.

Worker Information and Training

All new and current employees who work in areas where there is a reasonable likelihood of heat injury or illness should be kept informed through continuing education programs (hazards, effects, preventative measures, drug/alcohol interaction, etc.).

3.2.11 COLD STRESS

Cold stress is similar to heat stress in that it is caused by a number of interacting factors including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Fatal exposures to cold have been reported in employees failing to escape from low environmental air temperatures or from immersion in low temperature water. Hypothermia, a condition in which the body's deep core temperature falls significantly below 98.6°F (37°C), can be life threatening. A drop in core temperature to 95°F (35°C) or lower must be prevented.

Air temperature is not sufficient to determine the cold hazard of the work environment. The wind chill must be considered as it contributes to the effective temperature and insulating capabilities of clothing. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the body's core temperature.

The body's physiologic defense against cold includes constriction of the blood vessels, inhibition of the sweat glands to prevent loss of heat via evaporation, glucose production, and involuntary shivering to produce heat by rapid muscle contraction.

The frequency of accidents increases with cold temperature exposures as the body's nerve impulses slow down, individuals react sluggishly, and numb extremities make for increased clumsiness. Additional safety hazards include ice, snow blindness, reflections from snow, and possible skin burns from contact with cold metal.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 95°F (35°C). This must be taken as a sign of danger to the employees on site, and cold exposures should be immediately terminated for any employee when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Predisposing Factors for Cold Stress

There are certain predisposing factors that make an individual more susceptible to cold stress. It is the responsibility of the project team members to inform the SHO/SS to monitor an individual, if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a cold related illness or disorder.

Predisposing factors that will increase an individual's susceptibility to cold stress are listed below:

- **Dehydration:** The use of diuretics and/or alcohol, or diarrhea can cause dehydration. Dehydration reduces blood circulation to the extremities.
- **Fatigue During Physical Activity:** Exhaustion reduces the body's ability to constrict blood vessels. This results in the blood circulation occurring closer to the surface of the skin and the rapid loss of body heat.
- **Age:** Some older and very young individuals may have an impaired ability to sense cold.
- **Poor Circulation:** Vasoconstriction of peripheral vessels reduces blood flow to the skin surface.
- **Heavy Work Load:** Heavy workloads generate metabolic heat and make an individual perspire even in extremely cold environments. If perspiration is absorbed by the individual's clothing and is in contact with the skin, cooling of the body will occur.
- **The Use of PPE:** PPE usage that traps sweat inside the PPE may increase an individual's susceptibility to cold stress.
- **Lack of Acclimatization:** Acclimatization, the gradual introduction of workers into a cold environment, allows the body to physiologically adjust to cold working conditions.
- **History of Cold Injury:** Previous injury from cold exposures may result in increased cold sensitivity.

Prevention of Cold Stress

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing cold related ailments and disorders. These include acclimatization, fluid and electrolyte replenishment, eating a well balanced diet, wearing warm clothing, the provision of shelter from the cold, thermal insulation of metal surfaces, adjusting work schedules, and employee education.

- **Acclimatization:** Acclimatization is the gradual introduction of workers into the cold environment to allow their bodies to physiologically adjust to cold working conditions. However, the physiological changes are usually minor and require repeated uncomfortably cold exposures to induce them.
- **Fluid and Electrolyte Replenishment:** Cold, dry air can cause employees to lose significant amounts of water through the skin and lungs. Dehydration affects the flow of blood to the extremities and increases the risk of cold injury. Warm, sweet, caffeine-free, non-alcoholic drinks and soup are good sources to replenish body fluids.
- **Eating a Well Balanced Diet:** Restricted diets including low salt diets can deprive the body of elements needed to withstand cold stress. Eat high-energy foods throughout the day.
- **Warm Clothing:** It is beneficial to maintain air space between the body and outer layers of clothing in order to retain body heat. However, the insulating effect provided by such air spaces is lost when the skin or clothing is wet.
- **Work/Rest Regimes:** Schedule work during the warmest part of the day, if possible. Rotate personnel and adjust the work/rest schedule to enable employees to recover from the effects of cold stress.

The parts of the body most important to keep warm are the feet, hands, head, and face. As much as 40 percent of body heat can be lost when the head is exposed.

3.2.12 ADVERSE WEATHER CONDITIONS

The SS shall decide on the continuation or discontinuation of work based on current and pending weather conditions. Electrical storms, heavy rains, hurricanes, tornado warnings, and sustained strong winds (approximately 40 mph) are examples of conditions that would call for the discontinuation of work and evacuation of site.

In addition, no work with elevated super structures (e.g., drilling, crane operations, etc.) will be permitted during any type of electrical storm or during wind events that have wind speeds exceeding 40 mph.

3.2.13 SPECIAL WORK CONDITIONS/SITUATIONS

CRA may be asked to conduct work that requires special precautions/considerations due to the following factors:

- Remote work locations.
- Project site is in an area known for high crime or violence activity.
- Entry into abandoned buildings.
- Entry into wooded areas during hunting season.

If these situations are a potential, please consult with your Regional Safety Manager to develop a plan.

3.3 BIOLOGICAL HAZARDS

CRA employees conduct numerous project activities that have the possibility of encountering biological hazards, which include bloodborne pathogens, insects, spiders, rodents, snakes, and large predators. This section identifies precautions to be taken if these hazards are encountered.

3.3.1 VEGETATION OVERGROWTH

Overgrown weeds, bushes, trees, grass and other vegetation are fire and safety hazards. There are a number of hidden hazards not immediately recognized due to the overgrowth of vegetation in areas where field activities may occur, including discarded junk, litter, and debris. Construction materials such as boards, nails, concrete, and other debris may be hidden beneath blades of tall grass, weeds, and bushes. Other hazards may include steep slopes, potholes, trenches, soft spots, dips, etc.; all dangerously concealed from the view of the individual walking or operating motorized equipment in the area. Additionally, there are biological hazards such as snakes, ticks, chiggers, and mosquitoes that breed in overgrowth conditions.

Here are some simple actions you can take:

- Assess the work area and determine if the area requires vegetation clearance. Consider that overgrowth that extends above the lowest level of motorized equipment (i.e., bumper or fender) or 6 inches above your ankle has hidden hazards that you will not be able to readily identify.
- Determine if the area is safe to walk or whether you need motorized equipment. Consider the limitations of the equipment.
- Identify slip, trip, and fall hazards and remove from the general work area. Remember to give adequate clearance so that the items being removed do not pose future hazards.
- Adequately protect yourself against the hazards by wearing boots that protect the ankles, long pants, and using insecticides.
- Consider the limitations of manual or mechanical equipment for the clearance of overgrowth, particularly the safety hazards when using sling blades, machetes, weed eaters, bush hogs, or other brush removing equipment.

Before taking any action, determine whether there any ecological issues that would affect or prevent the removal of overgrowth in protected areas such as wetlands, wildlife habitats, or sanctuaries for endangered and/or protected species.

3.3.2 POISONOUS PLANTS

Common *Poison Ivy* grows as a small plant, a vine, and a shrub. Poison Ivy occurs in every state. The leaves always consist of three glossy leaflets. *Poison Sumac* grows as a woody shrub or small tree 5 to 25 feet tall. It usually contains nine leaves, with eight paired leaves and one on top, and is common in swampy areas. The plants are potent sensitizers and can cause a mild to severe allergic reaction, referred to as "contact dermatitis". *These plants are found in the U.S. and Canada.*

Dermatitis, in Rhus-sensitive persons, may result from contact with the milky sap found in the roots, stems, leaves, and fruit, and may be carried by contacted animals, equipment or apparel.

The best form of prevention is to avoid contact. Wearing long sleeves and gloves, and disposable clothing, such as Tyvek, is recommended in high-risk areas to avoid

exposure from contaminated apparel. Barrier creams and cleaners are also recommended.

3.3.3 INSECTS

Ticks

Ticks are blood feeding external parasites of mammals, birds, and reptiles throughout the world. Some human diseases of current interest in the United States caused by tick-borne pathogens include Lyme disease, ehrlichiosis, babesiosis, rocky mountain spotted fever, tularemia, and tick-borne relapsing fever. Lyme disease is caused by a bacterial parasite called spirochete and is spread by infected ticks that live in and near wooded areas, tall grass, and brush. The ticks that cause the disease in the Northeast and Midwest are often no bigger than a poppy seed or a comma in a newsprint. The peak months for human infection are June through October. There are many other tick borne diseases such as Rocky Mountain Spotted Fever, which can be carried by a variety of ticks. The prevention and treatment of these diseases are similar to those of Lyme disease.

Prevention

Preventative measures include wearing light-colored clothing, keeping clothing buttoned, tucking pant legs in socks, and keeping shirttails tucked in. Periodic checks for ticks should be made during the day, and especially at night. Hair should also be checked by parting it and combing through it to make sure that no ticks have attached to the scalp. Also, check clothing when it is first removed, before ticks have a chance to crawl off.

The most common repellent recommended for ticks is N,N-dimethyl-m-toluamide, or DEET. It is important to follow the manufacturer's instructions found on the container for use with all insecticides especially those containing DEET.

In general, DEET insect repellent should only be applied to clothing, not directly on the skin. Do not apply to sunburns, cuts, or abrasions. Use soap and water to remove DEET once indoors.

Removal

The best way to remove a tick is removal by tweezers. If tweezers are not available, cover your fingers (tissue paper) while grasping the tick. It is important to grasp the tick

as close as possible to the site of attachment and use a firm steady pull to remove it. When removing the tick, be certain to remove all the mouth parts from your skin so as not to cause irritation or infection. Wash hands immediately after with soap and water, and apply antiseptic to the area where tick was removed. Get medical attention if necessary.

Symptoms of Lyme Disease

The first symptoms of Lyme Disease usually appear from 2 days to a few weeks after a person is bitten by an infected tick. Symptoms usually consist of a ring-like red rash on the skin where the tick attached, and is often bulls eye like with red on the outside and clear in the center. The rash may be warm, itchy, tender, and/or "doughy" and appears in only 60 to 80 percent of infected persons. An infected person also has flu-like symptoms of fever, fatigue, chills, headaches, a stiff neck, and muscle aches and pains (especially knees). Rashes may be found some distance away from original rash. Symptoms often disappear after a few weeks.

Bees, Wasps, and Yellow Jackets

Insects that sting are members of the order Hymenoptera of the class Insecta. There are two major subgroups: aphids (honeybees, bumblebees) and vespids (wasps, yellow jackets, hornets). Aphids are docile and usually do not sting unless provoked. The stinger of the honeybee has multiple barbs, which usually detaches after a sting. Vespids have few barbs and can inflict multiple stings.

Types of stinging insects that might be encountered on this project site may include:

- Carpenter Bees
- Africanized Killer Bees
- Honeybees
- Bumblebees
- Cicada Killer Wasps
- Paper Wasps
- Mud Dauber Wasps
- Giant Hornets
- Yellow Jackets

Symptoms

If you are stung there are three types of reactions you can have, a normal, a toxic, or an allergic reaction.

- Normal reaction - only lasts a few hours and consists of pain, redness, swelling, itching, and warmth near the sting area.
- Toxic reaction - will last for several days and results from multiple stings and may cause cramps, headaches, fever, and drowsiness.

- Allergic reaction - might cause hives, itching, swelling, tightness in the chest area and a possibility of breathing difficulties, dizziness, unconsciousness, and cardiac arrest.

The stingers of many *Hymenoptera* may remain in the skin and should be removed as quickly as possible without concern for the method of removal. An ice cube placed over the sting will reduce pain; aspirin may also be useful. Persons with known hypersensitivity to such stings should carry a kit containing epinephrine in a prefilled syringe. Antihistamines may help decrease hives and angioedema. Persons who have severe symptoms of anaphylaxis, have positive venom skin test results, and are at risk for subsequent stings should receive immunotherapy regardless of age or time since anaphylaxis.

Precautions

The following precautions can help you avoid stings. Try to wear light colored clothing and shy away from dark or floral prints. Avoid wearing perfumes, hairsprays, colognes, and scented deodorants while working outside. If eating outside, keep all food and drinks covered; sweet foods and strong scents attract stinging insects as well. Never swat or swing at the insect, it is best to wait for it to leave, softly blow it away, or gently brush it aside. Seek medical attention when the reaction to a sting includes swelling, itching, dizziness or shortness of breath.

If physical control measures are not effective, use a pesticide that will have a minimal impact on both you and the environment.

Mosquitoes

Mosquitoes are common pests that can be found in any state and any work environment where warm, humid conditions exist. Mosquitoes can pass along diseases such as West Nile virus and Malaria. Several different methods can be used to control adult mosquito populations: repellants such as DEET, mosquito traps, foggers, and vegetation and water management. *Mosquitoes are found from the tropics to the Arctic Circle and from lowlands to the peaks of high mountains.*

3.3.4 POISONOUS SPIDERS

Black Widow

Black Widow spiders are not usually deadly (especially to adults) and only the female is venomous. The female spider is shiny black, usually with a reddish hourglass shape on the underside of her spherical abdomen. Her body is about 1.5 inches long while the adult male's is approximately half that. The spider's span ranges between 1 to 3 inches. The adult males are harmless, have longer legs, and usually have yellow and red bands and spots over their back, and the young black widows are colored orange and white. The bite of a black widow is often not painful and may go unnoticed. However, the poison injected by the spider's bite can cause severe reactions in certain individuals.

Symptoms

Symptoms that may be experienced include abdominal pain, profuse sweating, swelling of the eyelids, pains to muscles or the soles of the feet, salivation and dry-mouth (alternating), and paralysis of the diaphragm. If a person is bitten, they should seek immediate medical attention. Clean the area of the bite with soap and water. Apply a cool compress to the bite location. Keep effected limb elevated to about heart level. Ask doctor if Tylenol or aspirin can be taken to relieve minor symptoms. Additional information can be obtained from the Poison Center (1-800-222-1222). *Black widows are found throughout the tropics, U.S. and Canada.*

Brown Recluse

Brown recluse spiders are usually light brown in color, but in some instances they may be darker. Brown recluse spiders are highly venomous spiders, native to the United States and found coast to coast. The brown recluse can vary in size, but some can obtain bodies of 5/8 inches in length with a leg span of 1 1/2 inches in diameter. They can be identified by their three pairs of eyes along the head area and their fiddle shaped markings on the back. Most brown recluse bites are defensive rather than offensive. They generally only bite when they feel threatened.

Symptoms

If bitten by a brown recluse, an individual may experience open, ulcerated sores, which when left untreated may become infected and cause tissue necrosis. If an individual believes a spider has bitten them, they need to seek medical attention as soon as possible. In order to minimize the occurrence of brown recluse bites, individuals should shake their clothing and shoes thoroughly, eliminate the presence of cluttered areas, and

spray the building perimeters with pesticides. *Brown recluse are found throughout the U.S., Mexico, and Canada.*

3.3.5 THREATENING DOGS

If you are approached by a frightened or menacing dog:

- Do not attempt to run and don't turn your back.
- Stay quiet, and remember to breathe.
- Be still, with arms at sides or folded over chest with hands in fists.
- Slowly walk away sideways.
- Don't stare a dog in the eyes, as this will be interpreted as a threat.
- Avoid eye contact.
- If you have a jacket, you could wrap it around your arm and should he snap, take the bite harmlessly.
- Try calling it's bluff. Yell "sit!", "stay!", or "go home!". You might convince the dog that you are the stronger in the situation.

3.3.6 SNAKES

Snakes may be found in any region of the country. While many snakes encountered are not venomous, a few are; so it is best that you give a wide berth to all snakes. Of the 7,000 venomous snakebites reported each year, only about 15 prove to be fatal; so your chances of survival are extremely high. The usual snake encounter is one in which they see you before you see them, and they slither away from you quickly, startling you. If you see a snake, back away from it slowly and do not touch it. If you or someone you know are bitten, try to see and remember the color and shape of the snake, which can help with treatment of the snakebite.

Venomous snakes include the Coral Snake, Cobra, and Pit Vipers, such as the Cottonmouth (Water Moccasin), Copperhead, and Rattlesnake. The venom of pit vipers is primarily *hematoxic* because it acts upon the victim's blood system. This venom breaks down blood cells and blood vessels and affects heart action. Bite victims experience severe burning pain, localized swelling and discoloration for the first 3 to 30 minutes, followed by nausea, vomiting, and occasional diarrhea and usually shock.

Preventing Snakebites

Watching where you step, put your hands, or sit down is one of the best ways to prevent snakebites. Poisonous snakes live on or near the ground and often like rocks, woodpiles, and other spots that offer both a place to sun and a place to hide. Most bites occur in and around the ankle. About 99 percent of all bites occur below the knee, except when someone accidentally picks up or falls on the snake.

Watching where you step and wearing boots in tall grass can prevent most snakebites. Another means to protect against snakebites is snake chaps.

Emergency First Aid for Poisonous Snakebite

Although it is important to obtain medical aid immediately, emergency first aid can slow the spread of poison from the bite. Remain calm and avoid unnecessary movement, especially if someone is with you. The rate of venom distribution throughout your body will be slower if you are still and quiet. *Do not* use home remedies, and *do not* drink alcoholic beverages.

In addition, learn the following procedures so you do not waste time before getting medical attention.

- If less than 60 minutes is required to reach a hospital or other medical aid, follow this procedure:
 - Apply a constricting band 2 to 4 inches on each side of the bite. The band should be loose enough to slip your finger under without difficulty, so that you do not cut off circulation completely. Properly applied, the constricting band can be left safely in place for 1 hour without adjustment.
 - If ice is available, place some in a towel, shirt, or other piece of cloth and apply it to the bite area. Do not bind it to the bite, but keep it loosely in place. Do not use the ice pack for more than *1 hour*. The objective is to cool the venom and slow its action, but not to freeze the tissue.
 - The primary function of the constricting band and ice pack is to slow the spread of venom through your body. Remove them slowly so there will not be a sudden rush of venom through your blood stream.

3.3.7 BLOODBORNE PATHOGENS

Hepatitis B is largely transmitted through exposure to bodily fluids containing the virus which could be found on refuse encountered in subsurface investigations. This includes medical wastes, contaminated needles and syringes, and so on. The primary method of transmission depends on the prevalence of the disease in a given area.

Prevention

Preventative measures include wearing appropriate PPE – leather work gloves, long sleeved shirt, and safety footwear. Several vaccines have been developed for the prevention of hepatitis B virus infection. These rely on the use of one of the viral proteins (hepatitis B surface antigen or HBsAg). The vaccine was originally prepared from plasma obtained from patients who had long-standing hepatitis B virus infection. However, currently these are more often made using recombinant technology, though plasma-derived vaccines continue to be used; the two types of vaccines are equally effective and safe.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

4.1 GENERAL

This section shall cover the applicable personal protective equipment (PPE) requirements, which shall include eye, face, head, foot, and respiratory protection.

The purpose of PPE is to shield or isolate individuals from the chemical and physical hazards that may be encountered during work activities.

4.2 TYPES OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

The type of PPE for a project will vary based on the Level of Protection required to protect the employee from site physical, chemical, biological, and thermal hazards.

4.2.1 TYPES OF PROTECTIVE MATERIAL

Protective clothing is constructed of a variety of different materials for protection against exposure to specific chemicals. No universal protective material exists. All will decompose, be permeated, or otherwise fail to protect under certain circumstances.

Fortunately, most manufacturers list guidelines for the use of their products. These guidelines usually concern gloves or coveralls and generally only measure rate of degradation (failure to maintain structure). It should be noted that a protective material may not necessarily degrade but may allow a particular chemical to permeate its surface. For this reason, guidelines must be used with caution. When permeation tables are available, they should be used in conjunction with degradation tables.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all site personnel using PPE:

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift.
- Inspect all clothing, gloves, and boots both prior to and during use for:
 - imperfect seams;
 - non-uniform coatings;
 - tears; and

- poorly functioning closures.
- Inspect reusable garments, boots, and gloves both prior to and during use for:
 - visible signs of chemical permeation;
 - swelling;
 - discoloration;
 - stiffness;
 - brittleness;
 - cracks;
 - any sign of puncture; and
 - any sign of abrasion.

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of chemicals will not be reused.

4.3 RESPIRATORY PROTECTION

Respiratory protection may be worn by personnel during project activities. Personnel required to work in these areas will wear an air-purifying respirator and follow the procedures and guidelines as described below and follow CRA's Respiratory Protection Program.

All personnel required to use this equipment shall first be instructed in how to properly fit a respirator to achieve the required face-piece-to-face seal for respiratory protective purposes. Conditions, which could affect this face seal, are the presence of beards, sideburns, eyeglasses, and the absence of upper or lower dentures.

The air-purifying respirator cartridge selected for use during project work at this site is a ***P-100 cartridge***. These cartridges have the ability to protect against the known contaminant concentrations.

All cartridges will be changed prior to breakthrough or at a minimum daily. Changes will also be made when personnel begin to experience increased inhalation resistance or breakthrough of a chemical warning property.

4.3.1 RESPIRATOR CLEANING

Respiratory equipment and other non-disposable equipment will be fully decontaminated and then placed in a clean storage area. Respirator decontamination will be conducted at a minimum once daily. Face pieces will be disassembled, the cartridges thrown away, and all other parts placed in a cleansing solution. After an appropriate amount of time in the solution, the parts will be removed and re-seated with tap water.

Face pieces will be allowed to air dry before being placed in sanitized bags, and then stored in a clean area.

4.4 LEVELS OF PROTECTION

The level of protection must correspond to the level of hazard known, or suspected, in the specific work area. PPE has been selected with specific considerations to the hazards associated with site activities. The specific PPE to be used for each activity is outlined in each JSA table located in Appendix B.

- All PPE will be disposed of and/or decontaminated at the conclusion of each workday as described below. Decontamination procedures will follow the concept of decontaminating the most contaminated PPE first.
- All disposable equipment shall be removed before meal breaks and at the conclusion of the workday and replaced with new equipment prior to commencing work.
- Eating, drinking, chewing gum or tobacco, and smoking are prohibited while working in areas where the potential for chemical and/or explosive hazards may be present. Personnel must wash thoroughly before initiating any of the aforementioned activities.

4.4.1 REASSESSMENT OF PROTECTION LEVELS

Protection levels provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or the review of the results of air monitoring or the initial exposure assessment-monitoring program, if one was conducted.

When a significant change occurs, the hazards shall be reassessed. Some indicators of the need for reassessment are:

- commencement of a new work phase;
- change in job tasks during a work phase;
- change of season/ weather;
- when temperature extremes or individual medical considerations limit the effectiveness of PPE;
- chemicals other than those expected to be encountered are identified;
- change in ambient levels of chemicals; and
- change in work scope, which affects the degree of contact with areas of potentially elevated chemical presence.

All proposed changes to protection levels and PPE requirements will be reviewed and approved prior to their implementation by the SS.

5.0 AIR MONITORING PROGRAM

Inhalation hazards are caused from the intake of vapors and contaminated dust. Air monitoring shall be performed while intrusive activities are taking place to detect the presence and relative level of those air contaminants which are inhalation hazards. The purpose of air monitoring is to identify and quantify airborne contaminants in order to determine the level of worker protection needed. Initial screening for identification is often qualitative, but the determination of its concentration (quantification) must wait subsequent testing.

The data collected throughout the monitoring effort shall be used to determine the appropriate levels of protection.

5.1 EXPOSURE MONITORING

Air monitoring equipment to be used during site activities shall consist of *dust monitors*.

5.1.1 DUST MONITORS

The MIE PDR Personal DataRam Monitor is a direct reading aerosol photometer. The DataRam monitor is designed to detect aerosol dust or respirable dust in the ambient air. Aerosol is a term to describe fine particulates (solid or liquid) suspended in air. Concentrations are evaluated by two scales, which reads from 0.01 to 10.0 mg/m³ and 0.1 to 100.0 mg/m³, respectively.

5.1.2 MONITORING FREQUENCY

A summary of the monitoring equipment and frequency for each work activity is presented in the job safety analysis tables. As noted in the table, the monitoring equipment listed per work activity relates to the initial level of protection. The monitoring frequency may be decreased if the work areas and activities are unchanging, the result of the first hour of monitoring indicate contaminant concentrations are non-detect, and no differing conditions are observed.

5.1.3 HEALTH AND SAFETY ACTION LEVELS

An action level is a point at which increased protection or cessation of activities is required due to the concentration of contaminants in the work area. All activities shall be initiated in Modified Level D. The appropriate actions are to be taken at designated action levels. The initial action level for site work is *1 mg/m³*.

In addition to the action level, an upgrade to Level C is required if:

- any symptoms occur, as described in Section 3.0;
- requested by an individual performing the task; and
- any irritation to eye, nose, throat, or skin occurs.

A work stoppage and evacuation (cease and desist) at the specific work area is required if levels in the breathing zone exceed the protection factor of the respirator.

6.0 SITE CONTROL

The purpose of site control is to minimize potential contamination of workers and protect the public from hazards found on site. Site control is especially important in emergency situations.

Site control and work area demarcation will be achieved through posting of signage and placement of barricades. All construction areas will have the appropriate signage posted. Barricades and warning signs will be placed to warn personnel of potential hazards. A standby person (spotter) may be utilized in place of barricades, where appropriate. The following materials may be used to barricade construction areas, crane swing radius, and control traffic, etc.:

- temporary fence;
- high visibility tape, rope, or chains;
- traffic cones;
- sawhorses; and
- wood or metal guardrails.

One pathway should be established for heavy equipment and one for personnel decontamination.

The majority of site operations, as well as access to the site, could be controlled from the support zone. The support trailer would provide for team communications and emergency response, and sanitary facilities (i.e., Porta-Potty). Appropriate safety and support equipment also will be located in this zone.

The support zone will be located upwind of site operations, if possible, and would be used as a potential evacuation point, if appropriate. No potentially contaminated personnel or materials are allowed in this zone.

During the project set up, the perimeter security will be inspected and fencing will be installed for security as needed.

All personnel and equipment will access the exclusion zone through the contaminant reduction zone (CRZ), where decontamination will occur. The exclusion zone will be delineated in the field by security tape and/or spray marking on the ground.

6.1 COMMUNICATION

Each member of the site entry team will be able to communicate with another entry team member at all times. Communications may be by way of an air horn, walkie-talkie, telephone, or hand signals.

The primary means for external communication are telephones and radio. If telephone lines are not installed at a site, all team members should:

- know the location of the nearest telephone; and
- have the necessary telephone numbers readily available.

The following standard hand signals will be mandatory for all employees to understand regardless of other means of communication:

- Hand gripping throat – Cannot breathe.
- Hands on top of head – Need assistance.
- Thumbs up – OK, I'm all right, I understand.
- Thumbs down – No, negative.
- Gripping partner's wrist, or gripping both of your own hands on wrist (if partner is out of reach) – Leave area immediately.

6.2 BUDDY SYSTEM

6.2.1 RESPONSIBILITIES

A buddy system shall be implemented when conducting intrusive activities on this site. This buddy shall be able to:

- provide his or her partner with assistance;
- observe his or her partner for signs of chemical exposure or temperature stress;
- periodically check the integrity of his or her partner's protective clothing; and
- notify emergency personnel if emergency help is needed.

6.3 SITE SECURITY

Site security is necessary to prevent the exposure of unauthorized, unprotected people to site hazards and to avoid interference with safe working procedures. Security shall be maintained outside of the actual work area(s) so as to prevent unauthorized entry into the work area(s). Members of the general public are to be protected from site hazards.

6.4 DECONTAMINATION

It is the responsibility of the SS to ensure that all personnel and pieces of equipment coming off site are properly decontaminated according to the procedures outlined below. Documentation of decontamination must be made in the field log notebook that will become part of the permanent project file.

6.4.1 PERSONNEL AND EQUIPMENT DECONTAMINATION PROCEDURES

All PPE will be disposed of and/or decontaminated at the conclusion of each workday as described below. Decontamination procedures will follow the concept of deconning the most contaminated PPE first.

All disposable equipment shall be doffed before meal breaks and at the conclusion of the workday and replaced with new equipment prior to commencing work.

Procedures for decontamination must be followed to prevent the spread of contamination and to eliminate the potential for chemical exposure.

Personnel: Decontamination will be initiated prior to exiting the contaminated work area and be completed in the Contamination Reduction Zone.

Modified Level D: First, remove outer protective wear. Remove gloves and properly dispose in designated waste container. Wash hands and face.

Level C: Wash and rinse outer gloves, boots and suit, and remove; then remove respirator; dispose of cartridges; wash respirator; remove inner gloves and dispose. Wash hands and face.

Handle all clothing inside out when possible.

Equipment:

All equipment must be decontaminated with Alconox/Liquinox solution or discarded upon exit from the contaminated area in a well-ventilated area. A temporary decon pad with a low-volume high-pressure washer will be setup on site during drilling operations. All decon materials will be drummed for subsequent disposal.

7.0 EMERGENCY PROCEDURES

7.1 ON-SITE EMERGENCIES

Emergencies can range from minor to serious conditions. Various procedures for responding to site emergencies are listed in this section. The PM or SS is responsible for contacting local emergency services, if necessary, for specific emergency situations. Various individual site characteristics will determine preliminary action to be taken to assure that these entry procedures are successfully implemented in the event of an emergency. Address necessary Facility/Client emergency protocols to ensure compatibility between this document and Facility/Client programs and/or expectations.

An Emergency Information Sheet containing the hospital location, directions, government agency phone numbers, emergency phone numbers, and a map with directions to the hospital is located in Appendix A.

7.2 ACCIDENT, INJURY, AND ILLNESS REPORTING AND INVESTIGATION

Any work-related incident, accident, injury, illness, exposure, or property loss must be reported to your supervisor, the SS, and *within 1 hour* through the CRA Accident Reporting System. Motor vehicle accidents must also be reported through this system. CRA's Accident Report Form, located in Appendix A, must also be filled out and provided to the SS. The report must be filed for the following circumstances:

- accident, injury, illness, or exposure of an employee;
- injury of a subcontractor;
- damage, loss, or theft of property; and/or
- any motor vehicle accident, regardless of fault, which involves a company vehicle, rental vehicle, or personal vehicle while the employee is acting in the course of employment.

Occupational accidents resulting in employee injury or illness will be investigated by the SS. This investigation will focus on determining the cause of the accident and modifying future work activities to eliminate the hazard.

All employees have the obligation and right to report unsafe work conditions, previously unrecognized safety hazards, or safety violations of others. If you wish to

make such a report, it may be made orally to your supervisor or other member of management, or you may submit your concern in writing, either signed or anonymously.

7.3 EMERGENCY EQUIPMENT/FIRST AID

Safety equipment will be available for use by site personnel, will be located within 30 feet of the work area(s), and will be maintained at the site. The safety equipment will include, but is not limited to, the following: a 10-unit first aid kit (dependant upon the number of personnel), emergency alarm (e.g., air horn), emergency eyewash, an ABC fire extinguisher (2A/10BC), potable water, anti-bacterial soap, and telephone.

1. **First-degree burns** are superficial but can be painful because these burns usually do not damage the nerves. These types of burns will cause outer layers of skin to redden or discolor and to swell slightly.
2. **Second-degree burns** penetrate skin more deeply and are more severe than first-degree burns. In addition, second-degree burns affect skin by creating a red or mottled appearance, blisters, and swelling. These burns are also very painful because the nerve endings are still intact.
3. **Third-degree burns** are the most severe burns and have the deepest penetration of the types of burns. Third-degree burns may appear white or charred. They may even look like second-degree burns but they extend through all skin layers. In addition, third-degree burns destroy nerve endings, so third-degree burns can be less painful than second-degree burns.

Burns must be treated by medical personnel. However, you may need to provide first aid until professional help arrives. Listed below are several actions that you can take if someone is burned:

- Cool minor burns with water.
- Refrain from applying ice to any but the most minor first-degree burns.
- Refrain from breaking open blisters.
- Refrain from touching a burned area because touching the burned area increases the risk of infection.
- Refrain from applying ointment to a severe burn.
- Refrain from removing anything stuck to a burned area.

7.4 EMERGENCY PROCEDURES FOR CONTAMINATED PERSONNEL

Whenever possible, personnel should be decontaminated in the contamination reduction zone before administering first aid, without causing further harm to the patient.

Skin Contact: Remove contaminated clothing, wash immediately with water, and use soap, if available.

Inhalation: Remove victim from contaminated atmosphere. Remove any respiratory protection equipment. Initiate artificial respiration, if necessary. Transport to the hospital.

Ingestion: Remove from contaminated atmosphere. Do not induce vomiting if victim is unconscious. Also never induce vomiting when acids, alkalis, or petroleum products are suspected. Transport to the hospital, if necessary.

Any person transporting an injured/exposed person to a clinic or hospital for treatment should take with them directions to the hospital and a listing of the contaminants of concern to which they may have been exposed.

Any vehicle used to transport contaminated personnel will be cleaned or decontaminated, as necessary.

7.5 SITE EVACUATION

In the event of an emergency situation such as fire, explosion, significant release of toxic gases, etc., an air horn or other appropriate device will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. Personnel in the field will be notified through established communications to evacuate the area. In the event of an emergency, CRA personnel will gather at their primary mustering point for a head count. The mustering point location will be determined by the SHO and SS and will be communicated to the work crew(s) during the site-specific training prior to commencement of work activities.

7.6 SPILL AND RELEASE CONTINGENCIES

If a spill has occurred, the first step is personal safety, then controlling the spread of contamination, if possible. CRA personnel will immediately contact site management to inform them of the spill and activate emergency spill procedures.

8.0 RECORDKEEPING

The SS shall establish and maintain records of all necessary and prudent monitoring activities as described below:

- name and job classification of the employees involved on specific tasks;
- air monitoring/sampling results and instrument calibration logs;
- records of training acknowledgment forms (site-specific training, toolbox meetings, etc.;
- documentation of site inspections, results of inspections, and corrective actions implemented;
- records of OSHA Training Certifications for site personnel (40-Hour HAZWOPER, 8-hour refreshers, etc.;
- records of qualitative fit-testing and physical examination results for site personnel (as necessary); and
- emergency reports describing any incidents or accidents.

TABLE 1

PROPERTIES OF POTENTIAL SITE CONTAMINANTS

<i>Chemical Name (Synonyms)</i>	<i>Concentration at Site</i>	<i>Exposure Limits</i>	<i>Routes Of Entry</i>	<i>Symptoms/Health Effects</i>	<i>Chemical Properties</i>	<i>Physical Characteristics</i>
Lead (metal) CAS-7439-92-1		TLV: 0.05 mg/m ³ PEL: 0.05 mg/m ³ STEL: NE IDLH: 100 mg/m ³	Inhalation Ingestion Skin contact Eye contact	ACUTE: Lead is a cumulative poison, however, it may cause eye and skin irritation. CHRONIC: Effects blood, bone marrow, CNS, PNS and kidneys resulting in anemia, convulsions, peripheral nerve disease and kidney impairment. Toxicity to human reproduction or development.	(FP) NA (VP) NA (IP) NA (UEL) NA (LEL) NA	A heavy, ductile, soft, gray solid. Turns tarnished on exposure to air.
Polychlorinated Biphenyls PCB (42%) Chlorodiphenyl (42% chlorine) Aroclor 1242 CAS-53469-21-9		TLV: .001 mg/m ³ [skin] PEL: 1 mg/m ³ [skin] STEL: NE IDLH: 5 mg/m ³	Inhalation Absorption (skin) Ingestion	ACUTE: Eye irritation. CHRONIC: Dermatitis, chloracne, liver damage.	(FP) NA (VP) 0.001 mm (IP) NE (UEL) NA (LEL) NA	Colorless to light colored viscous liquid with a mild hydrocarbon odor.
Polychlorinated Biphenyls PCB (54%) Chlorodiphenyl (54% chlorine) Aroclor 1254 CAS-11097-69-1		TLV: 0.001 mg/m ³ [skin] PEL: 0.5 mg/m ³ [skin] STEL: NA IDLH: 5 mg/m ³	Inhalation Absorption (skin) Ingestion	ACUTE: Eye irritation. CHRONIC: Dermatitis, chloracne, liver damage.	(FP) NA (VP) 0.00006 mm (IP) NA (UEL) NA (LEL) NA	Colorless to pale yellow viscous liquid or solid (<50°F) with a mild hydrocarbon odor.

APPENDIX A

FORMS

1. EMERGENCY CONTACT SHEET
2. HASP ACKNOWLEDGEMENT FORM
3. TAILGATE SAFETY MEETING FORM
4. CRA INCIDENT REPORTING FORM
5. CRA NEAR LOSS REPORTING FORM
6. SAFE TASK EVALUATION PROCESS (STEP) FORM
8. SAFETY INSPECTION CHECKLIST FOR EXCAVATION
7. PROPERTY ACCESS/UTILITY CLEARANCE DATA SHEET

CRA Jefferson Yard Site

EMERGENCY INFORMATION		
Contact	Phone Number	Hospital Directions
Local Police	847-289-2700 911	Start out going EAST on JEFFERSON AVENUE toward N GROVE AVENUE (0.3 mi) Turn LEFT onto N SPRING STREET (0.4 mi) Turn RIGHT onto SLADE AVENUE (0.1 mi) Turn LEFT onto CENTER STREET (0.1 mi) End at 934 Center Street, Elgin, IL 60120 Driving Time: 2 minutes Driving Distance: 0.78 miles Attach Map.
Fire Department	847-931-6178 911	
Ambulance	847-931-6178 911	
Local Hospital: Sherman Hospital 934 Center Street Elgin, IL 60120	847-742-9800	
National Poison Center	800-222-1222	CRA – Accident Reporting System Please call (866) 529-4886 and provide: <ul style="list-style-type: none"> Name and location of caller Description of incident Name of any injured persons Description of injuries Phone number for return call.
Project Manager Ron Frehner <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>	651-639-0913 612-817-6925	
Site Supervisor Walt Pochron <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>	773-380-9725	
CRA Regional S&H Manager William Doyle <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>	734-357-5517 734-536-1282	
Site Contact <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>		
Client Contact Alan Bielawski <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>	312-853-2662	
Other Contact <div style="text-align: right; padding-right: 10px;"> Work: Cell: </div>		

* Hospital Route must be field validated before site work commences.

MAP TO HOSPITAL

SITE ADDRESS:

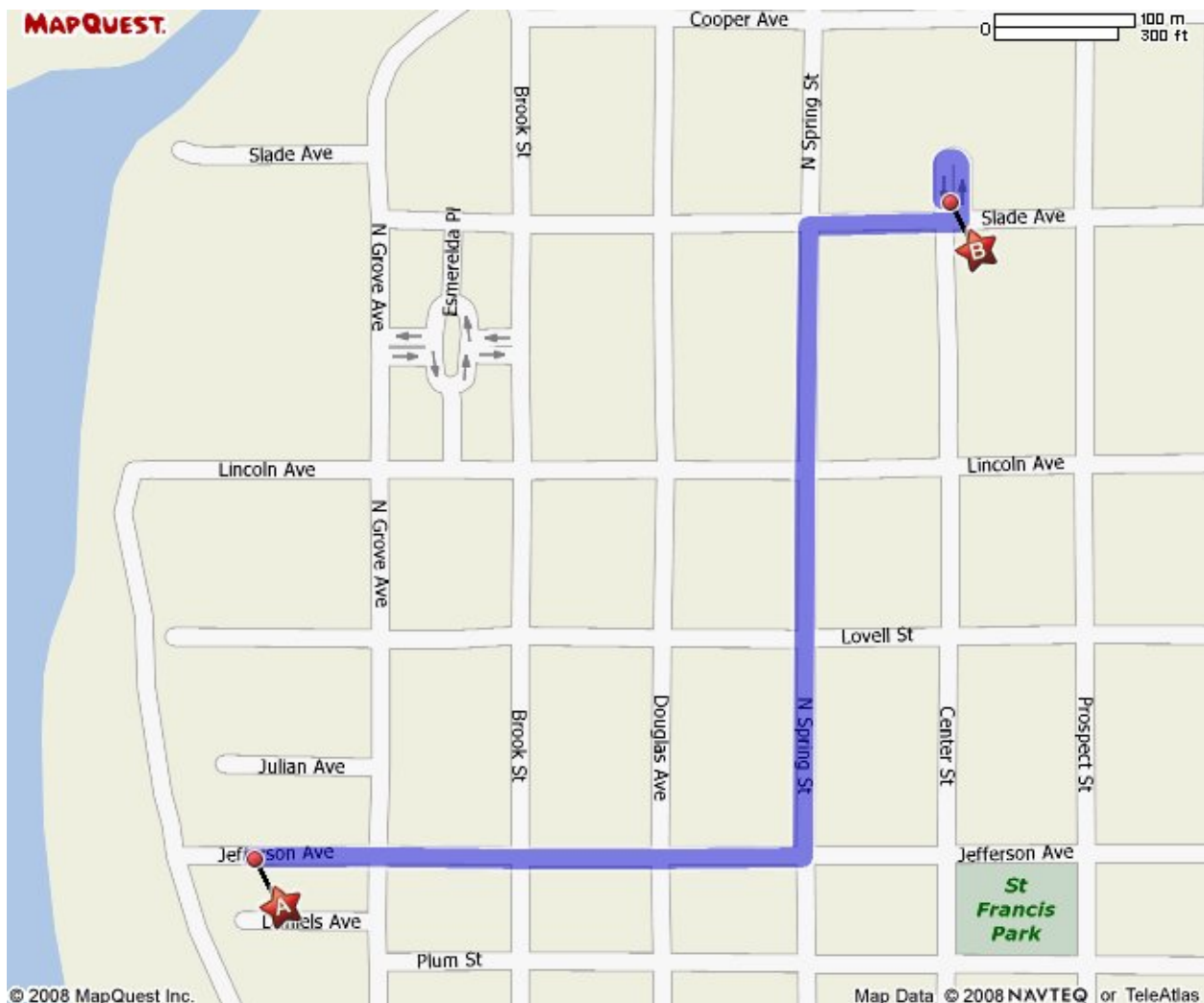
20 Jefferson Avenue
Elgin, Illinois 60120

HOSPITAL ADDRESS:

Sherman Hospital
934 Center Street
Elgin, Illinois 60120

DIRECTIONS:

Start out going EAST on JEFFERSON AVE toward N GROVE AVE. (0.3 mi)
Turn LEFT onto N SPRING ST. (0.4 mi)
Turn RIGHT onto SLADE AVE. (0.1 mi)
Turn LEFT onto CENTER ST. (0.1 mi)
End at 934 Center St Elgin, IL 60120



HASP ACKNOWLEDGMENT SHEET

This is to certify that I have received a pre-entry briefing regarding this HASP (CRA *Jefferson Yard* Site) and I understand its contents. My failure to follow and comply with the requirements contained in this plan may result in disciplinary action and/or termination.

[illegible]

TAILGATE SAFETY MEETING FORM

CRA Jefferson Yard Site

Project Number: 054633

Date: _____ Time: _____

Site Location: 20 Jefferson Avenue, Elgin, IL 60120

Site Personnel in attendance:

Print Name	Signature	Company
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Safety Topics/Items discussed:

Supervisor

Name: _____ Date: _____

CONESTOGA-ROVERS & ASSOCIATES (CRA) INCIDENT REPORTING FORM

Incidents must be called into Incident Hot Line: 1-866-529-4886

Instructions: For Personal Injuries, Occupational Illnesses, and Property Damage, complete Sections 1 and 2.
For Vehicle Accidents, Complete Sections 1, 2, and 4. Initial report must be submitted within 24 hours.

SECTION 1

Report Status - Insert Date: (/ /) Initial Report (/ /) Update Report (/ /) Final Report (/ /) Verification/Validation											
A. Employee Identification () CRA Employee () Temporary Employee () Subcontractor											
Employee No.		Last Name			First Name			Middle Name/Initial		M or F	
Area Code ()		Telephone Number		Address (Street, City, State, Province, Zip Code)							
Date of Hire / /		Position/Title			Supervisor			Employee's Company/Office Location			
B. General Information											
Where did the incident occur? () Office () Project Site () Other _____ () Canada () United States					Type of Loss (Check all that apply) () Employee Injury/Illness () Vehicle Accident () Property Damage Only						
Address of Incident (City, State, Province, Zip Code)					Specific Location of Incident (e.g., where on site)						
Date and Hour of Loss			Date and Hour Reported to Employer			Date and Hour Last Worked			Time Employee Began Work		
Month	Day	Year	a.m.	p.m.	Month	Day	Year	a.m.	p.m.	a.m.	p.m.
Normal Work Hours on Last Day Worked			Witnesses?		Witness Name and Telephone Number						
From: a.m.			() Yes () No								
To: p.m.											
C. Project Information (Project Related Loss Only) Project Related: () Yes () No											
Project #		Project Name		Project Manager		Site Telephone Number ()		Project Manager Cell Number ()			
Was the Client Advised of the Loss? () Yes () No				Name			Date & Time				

SECTION 2

A. Details of the Loss	
1. What job/task was being performed when the incident occurred? (Example: collecting groundwater samples).	
2. Provide a detailed description of the employee's specific activities at the time of the accident. Include details of equipment/materials being used, including the size and weights of objects being handled. If necessary, attach additional pages to the report.	
3. For injuries, identify the specific part of body injured, and specify left or right side. For illnesses, identify and describe the affected area/body part.	
4. Identify the object or substance that directly injured employee and how. Include size and weight of object, quantity of substance, etc.	
5. Identify property damaged and how it was damaged (include owner of property, nature and source of damage, model and serial number, if appropriate).	
B. Health Care/Medical Treatment	
Employee received health care? () Yes () No	Identify the type of health care provided and where it was performed. (Check all that apply). () First Aid () Medical treatment other than first aid (sutures, etc.) () Hospitalized () Clinic () Hospital emergency room () On location by self or CRA employee () On site by EMT
Name of Health Care Provider, Physician's Name, Address (Street, City, State, Province/State, and Postal/Zip Code)	
C. Loss Investigation () 5 Why Root Cause Analysis Investigation [Non-OSHA Recordable, <\$1,000 damage] () Tap Root Root Cause Analysis [OSHA Recordable, and/or >\$1,000 damages]	
HASP prepared? () Yes () No () Not applicable Submit a PDF of HASP and relevant JSA(s) to Investigation Team. If yes, what the HASP on-site? () Yes () No	Did the safety plan identify and provide safety procedures for the specific tasks the employee was conducting when injured? () Yes () No If no, why not? (Explain) _____ Did the employee utilize the STAR process before initiating the task? () Yes () No If no, why not? (Explain) _____ Was the employee post incident drug & alcohol tested () Yes () No

SECTION 2 (Continued)

5 Why Root Cause:		
1. Why did "above" happen?	Verification	
2. Why did "1" happen?		
3. Why did "2" happen?		
4. Why did "3" happen?		
5. Why did "4" happen?		
6. Why did "5" happen?		
Additional information: Attach photos, witness statement(s), affected employee statement, diagrams, as applicable, to the end of this document.		
See the Causative Factors & Corrective Actions		
D. Accountability		
Initial Report Date Month Day Year	Initial Report Prepared by: (please print)	Initial Report Prepared by: (signature)
Investigation Team	Company	Position/Title
Final Report Date Month Day Year	Final Report Prepared by: (please print)	Final Report Prepared by: (signature)
E. Stewardship		
Will an Incident Summary be Prepared () Yes () No By:	Disciplinary Action Taken? () Yes () No	
Quality Review By:	Date:	Findings:

*Fax Completed Form to CRA's Incident Reporting Fax: (832) 485-5259
Send Original to CRA's Incident Reporting Department, Houston, Texas*

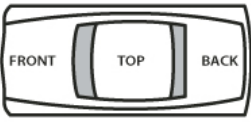
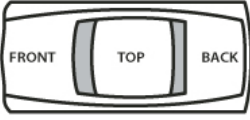
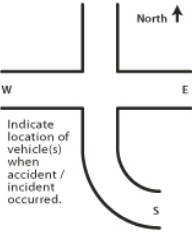
SECTION 3

D. Agency Reporting and Recording Information (To be completed by the Regional Safety and Health Manager)			
CANADA			
Form 7 Sent to WSIB? () Yes () Not required	Employee Injury Information (Injury met the following criteria) () First Aid () Medical Treatment () Critical Injury () Modified Duty () Lost Time Injury If medical treatment, what?		
Joint Safety and Health Committee Notified? () Yes () No	Total days of modified duty If exceeds 7 days, report to WSIB.	Total days of lost time (if any)	Date employee returned to work Month Day Year
UNITED STATES			
OSHA Recordable Injury? () Yes () No	Employee Injury Information (Injury met the following OSHA 300 Log criteria) () First Aid () Medical Treatment () Restricted Duty () Lost Time Injury If medical treatment, what?		
Total days of restricted duty	Total days of lost time (if any)		Date employee returned to work Month Day Year

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VEHICLE ACCIDENT SECTION
(Complete this Section for all Vehicle Accidents)

SECTION 4

A. CRA Vehicle				
License Plate No.		State/Province	Police Department	City State/Province
Vehicle Year/Make/Model		Odometer Reading at Time of Accident	Police Report Number	Weather Conditions
Name of Person Operating Vehicle			"X" IN AREA OF VEHICLE DAMAGE  <div style="display: inline-block; vertical-align: top; margin-left: 10px;"> CIRCLE 0 No Damage 1 Light 2 Moderate 3 Heavy 4 Rolled 5 Burned </div>	
Address				
City	State/Province	Zip Code		
Telephone: Area Code ()				
Vehicle Type: () Personal () Rental () CRA-Own				
Description of Vehicle Damage:				
B. Other Vehicles Involved				
Name of Owner		Address	City/State/Prov./Zip	Area Code and Telephone Number ()
Operator's Name (if different from above)		Address	City/State/Prov./Zip	Area Code and Telephone Number ()
Year/Make/Model	Description of Property Damage:		"x" IN AREA OF VEHICLE DAMAGE  <div style="display: inline-block; vertical-align: top; margin-left: 10px;"> CIRCLE 0 No Damage 1 Light 2 Moderate 3 Heavy 4 Rolled 5 Burned </div>	
Insurance Co. Name & Telephone				
License Plate No./State/Province				
C. Injured Persons				
Name	Address Street, City, State/Prov./Zip Code	Phone Number	Nature of Injury	Indicate if Injured was a Vehicle Driver/ Passenger, CRA Employee, Other, or Pedestrian
1.				
2.				
3.				
D. Witnesses				
Name	Address Street, City, State/Prov./Zip Code		Area Code and Telephone Number	
1.			()	
2.			()	
E. Description of Accident				
<div style="border: 1px solid black; padding: 5px;"> <p>PLEASE COMPLETE OR ATTACH SEPARATE DIAGRAM</p>  <p>Indicate location of vehicle(s) when accident / incident occurred.</p> </div>				
Was Ticket Issued: Other Operator <input type="checkbox"/> CRA Operator <input type="checkbox"/>		Reason: _____ _____ _____		
Report Date Month Day Year	Report Prepared by: (please print)		Report Prepared by: (signature)	

Note: If Additional Space is Required to Complete this Report, Use Separate Sheet of Paper and Attach.

Fax Completed Form to CRA's Incident Reporting Fax: (832) 485-5259
Send Original to CRA's Incident Reporting Department, Houston, Texas



Incident Report Corrective Action Verification and Validation



Safety Means Awareness
Responsibility Teamwork

Causative Factor(s) and Corrective Actions(s)						Verification (Did we do what we said we would do?) and Validation (Is it working?)		
Item No.	CF	Corrective Actions (Must match Causative Factor)	Responsible Party	Due Date	Date Completed	Verified By/ Validated By	Date	Details

CRA 10 CAUSATIVE FACTORS (CF)

Personal Factors		Company Factors		External Factors	
1	Insufficient training for task	5	Incomplete or no procedures	10	Exposure to conditions
2	Hurrying to complete the task	6	Procedures not known or enforced		
3	Easier if proper process not followed	7	Improper PPE		
4	Took shortcuts without prior incident	8	Improper tools		
		9	Improper workplace layout		

XXXXX (X)



CONESTOGA-ROVERS & ASSOCIATES (CRA) NEAR LOSS REPORTING FORM

A Significant Near Loss must be called into Incident Hot Line: 1-866-529-4886



Instructions: Complete the Near Loss Report and submit to your Supervisor

SECTION 1

Report Status – Insert Date: (/ /) Initial Report (/ /) Update Report (/ /) Final Report (/ /) Verification/Validation							
A. Employee Identification () CRA Employee () Temporary Employee () Subcontractor							
Employee No.		Last Name		First Name			
Date of Hire / /		Position/Title		Supervisor		Employee's Company/Office Location	
B. General Information							
Where did the Near Loss occur? () Office () Project Site () Other _____ () Canada () United States				Type of Near Loss (Check all that apply) () Employee Injury/Illness () Vehicle Accident () Property Damage () Environmental			
Address of Near Loss (City, State, Providence, Zip Code)				Specific Location of Near Loss (eg where on site)			
Date and Hour of Near Loss		Date and Hour Reported to CRA		Hours on Last Day Worked		Time Employee Began Work	
Month Year	Day a.m. p.m.	Month Year	Day a.m. p.m.	From: To:	a.m. p.m.	a.m. p.m.	
Witnesses? Yes () No ()			Witness Name and Telephone Number				
C. Project Information (Project Related Near Loss Only): Project Related: () Yes () No							
Project #	Project Name		CRA Project Manager	Client		Client Contact	
Was the Client Advised of the Near Loss? () Yes () No () N/A			Name:		Date & Time		

SECTION 2

A. Details of the Near Loss
1. What job/task was being performed when the Near Loss occurred? (Example: collecting groundwater samples).
2. Provide a detailed description of the employee's specific activities at the time of the Near Loss. Include details of equipment/materials being used, including the size and weights of objects being handled. If necessary, attach additional pages to the report.

B. Near Loss Investigation	
Conduct a 5-Why Root Cause Analysis Investigation. In addition, if there was the potential for a significant injury or loss report the Near Loss to Accident Hot Line so a Detailed Tap Root Cause Analysis	
HASP prepared? () Yes () No () Not applicable Submit a PDF of HASP to Investigation Team. If yes, what the HASP on-site? () Yes () No	Did the safety plan identify and provide safety procedures for the specific tasks being performed when the Near Loss occurred? () Yes () No If no, why not? (Explain) _____ Did the employee utilize the STAR process before initiating the task? () Yes () No If no, why not? (Explain) _____

5-Why Root Cause:		
1. Why did "above" happen?		Verification
2. Why did "1" happen?		
3. Why did "2" happen?		
4. Why did "3" happen?		
5. Why did "4" happen?		
6. Why did "5" happen?		
Additional information: Attach photos, witness statement(s), affected employee statement, accident diagrams, as applicable, to the end of this document.		
See the Causative Factors & Corrective Actions		
C. Accountability		
Initial Report Date Month Day Year	Initial Report Prepared by: (please print)	Initial Report Prepared by: (signature)
Investigation Team	Company	Position/Title
Final Report Date Month Day Year	Final Report Prepared by: (please print)	Final Report Prepared by: (signature)
D. Stewardship		
Will a Near Loss Summary be Prepared () Yes () No By:		
Quality Review By:	Date:	Findings:

SECTION 3

Corrective Action					Validation & Verification		
CF	Corrective Actions (Must match Causative Factor)	Responsible Party	Due Date	Date Completed	Verified By/ Validated By	Date	Details

CRA 10 CAUSATIVE FACTORS (CF)

Personal Factors		Company Factors		External Factors	
1	Insufficient training for task	5	Incomplete or no procedures	10	Exposure to conditions
2	Hurrying to complete the task	6	Procedures not known or enforced		
3	Easier if proper process not followed	7	Improper PPE		
4	Took shortcuts without prior incident	8	Improper tools		
		9	Improper workplace layout		



SAFE TASK EVALUATION PROCESS (STEP)



Report Status:				
(insert date)	Initial Report	Updated Report	Final Report	Verification/Validation

Date:	Time:	Project No. (if applicable):
Client:	Project Name:	
Office:	Work Group:	Site Location:
Subcontractor: <input type="checkbox"/> Yes <input type="checkbox"/> No	Subcontractor Company Name:	

Feedback Conducted By:	Date:	Time:
Observer's Name:	Observer's Supervisor:	

Check Task Being Observed (if not listed here, go to columns at right)		If checking this column, write in the specific task	
<input type="checkbox"/> Air Knifing	<input type="checkbox"/> Manual Lifting	<input type="checkbox"/> Agricultural Services	
<input type="checkbox"/> Clearing	<input type="checkbox"/> Mob/Demob	<input type="checkbox"/> Construction	
<input type="checkbox"/> Demolition	<input type="checkbox"/> Project Oversight	<input type="checkbox"/> Landfill	
<input type="checkbox"/> Drilling	<input type="checkbox"/> Soil Sampling	<input type="checkbox"/> Office Operations	
<input type="checkbox"/> Driving	<input type="checkbox"/> Stack Testing	<input type="checkbox"/> O&M	
<input type="checkbox"/> Electrical Work	<input type="checkbox"/> Surveys & Audits	<input type="checkbox"/> Pipeline	
<input type="checkbox"/> Excavation	<input type="checkbox"/> Traffic Control	<input type="checkbox"/> Refinery	
<input type="checkbox"/> General Site Cleaning	<input type="checkbox"/> UST Removal	<input type="checkbox"/> Treatment Plants	
<input type="checkbox"/> Heavy Equipment Operations	<input type="checkbox"/> Water Sampling	<input type="checkbox"/> Other	
<input type="checkbox"/> IH Sampling	<input type="checkbox"/> Well Management		

Background Information (Give a brief description of task being performed and your surroundings)

--

Observer's Positive Comments

--

Feedback Conclusion (Why the Questionable Items Occurred)

--



**CRA
SMART
PROGRAM**

Safety Means Awareness
Responsibility Teamwork

PERSONAL PROTECTIVE EQUIPMENT	Meets Work Standards	???	N/A	Evaluation Comments
1. Hearing Protection (e.g., Ear Plugs)				
2. Head Protection (e.g., Hard Hat)				
3. Eye Protection (e.g., Safety Glasses/Goggles)				
4. Hand Protection (e.g., Gloves)				
5. Foot Protection (e.g., Steel-toe Boots)				
6. Respiratory Protection				
7. Fall Protection (e.g., lanyard/harness)				
8. High Visibility Clothing (e.g., Work Vest)				
9. First Aid Kit/Fire Extinguisher				
10. Other (be specific)				
BODY POSITION	Meets Work Standards	???	N/A	Evaluation Comments
11. Proper Body Positioning When Exerting Force (Lifting/Pushing/Pulling)				
12. Pinch Points/Moving Equipment - Hands/Body Placement				
13. 3-Points of Contact				
14. Other (be specific)				
WORK ENVIRONMENT	Meets Work Standards	???	N/A	Evaluation Comments
15. Work/Walk Surface Clear (Free And Clear Pathway)				
16. Housekeeping/Equipment Storage				
17. Controlled Work Zone (e.g., Warning Devices, Barricades, Cones, Flags)				
18. Emergency Stop/Safety Switches				
19. Materials Labeled Correctly				
20. Storage/Disposal of Waste				
21. Other (be specific)				
OPERATING PROCEDURES	Meets Work Standards	???	N/A	Evaluation Comments
22. STAR Performed/Job Planning				
23. Stop Work Authority				
24. JSA/JLA Reviewed and Followed				
25. Daily Site Inspection				
26. High Risk Task Specific (Hot Work, Confined Space, LOTO, Excavation/Trenching)				
27. Inspect Work Zone for Hazards				
28. Coordinate/Communicate with Site Rep and/or other others on site				
29. Spotters used appropriately				
30. Underground/Overhead Utilities Identified				
31. Other (be specific)				
TOOLS/EQUIPMENT	Meets Work Standards	???	N/A	Evaluation Comments
32. Hand/Power Tool - Selection, Condition, and Use				
33. Field/Test Equipment - Selection, Condition, and Use				
34. Heavy Equipment - Selection, Condition, and Use				
35. Other (be specific)				
Observation Total Occurrences				
% Observations to Meet Work Standards				
Item Specific to Work Task	Meets Work Standards	???		Evaluation Comments
Insert Task/JSA/SOP Step				
Insert Task/JSA/SOP Step				
Insert Task/JSA/SOP Step				

[illegible]

CRA 10 CAUSATIVE FACTORS

Personal Factors		Company Factors		External Factors	
1	Insufficient training for task	5	Incomplete or no procedures	10	Exposure to conditions
2	Hurrying to complete the task	6	Procedures not known or enforced		
3	Easier if proper process not followed	7	Improper PPE		
4	Took shortcuts without prior incident	8	Improper tools		
		9	Improper workplace layout		

SAFETY INSPECTION CHECKLIST FOR EXCAVATIONS REFERENCED BY OSHA STANDARDS

This checklist is to be completed by the competent person at the start of work and as needed throughout the shift (i.e., after rain events, etc.). *(A competent person has been trained in the current OSHA excavation standard, is knowledgeable about soil analysis and protective systems, and has the authority to shut down the job.)*

Site Location: _____	Project #: _____
Date: _____ Time: _____	Competent Person: _____
Were visual soil tests made? If Yes, what type? _____	YES <input type="checkbox"/> NO <input type="checkbox"/> Type: _____
Were manual soil tests made? If yes, what type? _____	YES <input type="checkbox"/> NO <input type="checkbox"/> Type: _____
Soil Type: _____	Signature: _____
Soil Classification: _____	
Excavation Depth: _____	Excavation Width: _____
Protective System Used: _____	

In the following table, please place a Y for Yes, N for No, or N/A for Not Applicable in the right hand column for each item. If No, place the date of correction.

<i>Subject</i>		<i>Y, N, or NA</i>	<i>Date Corrected</i>
GENERAL INSPECTION OF THE JOB SITE			
1.	Does the competent person have the authority to remove employees from the excavation immediately?		
2.	Are surface obstructions removed or supported?		
3.	Are employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation?		
4.	Are hard hats worn by all employees?		
5.	Are excavated soil, materials, and equipment placed at least 2 feet from the edge of the excavation?		
6.	Are walkways and bridges over excavations 4 feet or more in depth equipped with standard guardrails and toe-boards?		
7.	Are warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic?		
8.	Are employees required to stand away from vehicles being loaded or unloaded?		
9.	Is a warning system established and used when mobile equipment operates near the edge of the excavation?		
10.	Are employees prohibited from going beneath suspended loads?		
11.	Are employees prohibited from working on the faces of sloped or benched excavations above other employees?		
UTILITIES			
12.	Were utility companies contacted and/or utilities located?		
13.	Are the exact locations of the utilities marked?		
14.	Are underground installations protected, supported, or removed when excavation is opened?		
MEANS OF ENTERING AND EXITING THE TRENCH			
15.	Is the distance along the trench to an exit no greater than 25 feet in excavations 4 feet or more in depth?		

<i>Subject</i>		<i>Y, N, or NA</i>	<i>Date Corrected</i>
16.	Is a support system, such as underpinning, being used?		
17.	Are ladders used in excavations secured and extended 3 feet above edge of the trench?		
18.	Are structural ramps used by employees designed by a competent person?		
19.	Are structural ramps used for equipment designed by a registered professional engineer?		
20.	Are employees protected from cave-ins when entering or exiting the excavation?		
WET CONDITIONS			
21.	Is water removal equipment monitored by a competent person?		
22.	Is surface water or runoff diverted or controlled to prevent accumulation in the excavation?		
23.	Are inspections made after every rainstorm or other hazard-increasing occurrence?		
HAZARDOUS ATMOSPHERE			
24.	Is the atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficiency, combustible, or other harmful contaminant exposing employees to a hazard?		
25.	Are adequate precautions taken to protect employees from exposure to an atmosphere containing less than 19.5% oxygen and/or other hazardous atmospheres?		
26.	Is ventilation provided to prevent employee exposure to an atmosphere containing flammable gas 10% above the lower explosive limit of a gas?		
27.	Is testing conducted often to ensure that the atmosphere remains safe?		
28.	Is emergency equipment, such as breathing apparatus, safety harness and lifeline, and/or basket stretcher readily available where hazardous atmospheres could or do exist?		
SUPPORT SYSTEMS			
29.	Are materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads?		
30.	Are materials and equipment used for protective systems inspected and in good condition?		
31.	Are protective systems installed without exposing employees to the hazards of cave-ins (including end walls), collapses, or threat of being struck by materials or equipment?		
32.	Are excavations below the level of the base, or footing supported, approved by a registered professional engineer?		
33.	Does the removal of support systems progress from the bottom and members are released slowly? Note any indication of possible failure.		
34.	Is the excavation of material a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth?		
35.	Is there a shield system placed to prevent lateral movement?		

PROPERTY ACCESS/UTILITY CLEARANCE DATA SHEET

(QSF-019)

PROJECT NAME: _____ PROJECT NUMBER: _____

CRA REPRESENTATIVE: _____

CLIENT: _____ CLIENT REPRESENTATIVE: _____ PHONE: _____

ON-SITE PROPERTY ACCESS APPROVAL	(OWNER OR AUTHORIZED AGENT SIGNATURE)
OFF-SITE PROPERTY ACCESS APPROVAL (if applicable)	(OWNER OR AUTHORIZED AGENT SIGNATURE)
UTILITY CLEARANCE APPROVAL	(OWNER OR AUTHORIZED AGENT SIGNATURE)
CONTRACTOR VERIFICATION APPROVAL	(OWNER OR AUTHORIZED AGENT SIGNATURE)

UTILITIES (INDICATE THAT LOCATION/UTILITY PRESENCE WAS CHECKED) *												
Borehole/ Excavation Location	Date (m/d/y)	Telephone	Water	Storm Sewer	Sanitary Sewer	Process Sewer	Gas	Electrical	Cable	Overhead Utilities	Other	Comments/Warnings

Additional Comments:

* Note as appropriate, Contractor, Client or Owner, or Agent to sign, indicating no utilities are at the selected borehole/excavation locations.

APPENDIX B

JOB SAFETY ANALYSIS TABLES



JOB SAFETY ANALYSIS (JSA)

Excavation Oversight



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Excavation Activities
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Excavation oversight		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Excavator; shoring with tabulated data sheet(s); ladder; air monitoring equipment (dust monitor); Excavation Safety Checklist		
Task-specific Training:	40-Hour and 8-Hour HAZWOPER; PPE; Mobile Equipment Operations; Excavation Safety Training; Excavation Competent Person		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input checked="" type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input checked="" type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Class II vest; leather gloves; Noise Reduction Rating (NRR) 20 hearing protection

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Excavation Oversight



Safety Means Awareness
Responsibility Teamwork

Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Perform the STAR process; discuss SWA; verify Permit to Excavate and Utility Clearance Form is completed (overhead and underground); verify excavation layout	<ul style="list-style-type: none"> Underground utility strike Overhead utilities 	<ul style="list-style-type: none"> QSF-019 and Permit to Excavate Forms completed and signed off Utility Locate Ticket number on file within 10 days of excavation startup? Mark work area and safe distances for overhead lines; use spotter as necessary 	CRA Construction Oversight Person
2	Set up necessary work area and traffic controls	<ul style="list-style-type: none"> Fall-in, caught-between, and struck-by hazards 	<ul style="list-style-type: none"> Demarcate site and work areas to ensure that personnel and truck/equipment traffic is maintained safely and smoothly Stockpile and laydown area are setup properly 	CRA Construction Oversight Person
3	Hand digging and potholing activities (where/if necessary based on utility locates)	<ul style="list-style-type: none"> Underground utility strike 	<ul style="list-style-type: none"> Use preventive techniques Maintain proper utility clearances with heavy equipment and use hand digging/potholing when necessary 	CRA Construction Oversight Person
1	Heavy equipment operations to excavate and handle soils and waste materials	<ul style="list-style-type: none"> Caught-between and struck-by hazards Underground/overhead utilities 	<ul style="list-style-type: none"> Stay out of swing radius Use spotters to verify clear route of travel and work area Maintain eye contact with operator and/or signal operator Keep soil 2 feet from edges Inspect heavy equipment and document inspection Ensure the above utility clearances and safe work protocols are followed 	CRA Construction Oversight Person
2	Excavating activities	<ul style="list-style-type: none"> Soil cave-in Noise hazard Struck-by/against hazards Potential contact with chemical waste material, organic vapors, and particulate 	<ul style="list-style-type: none"> Keep proper distances from edge of excavation Limit equipment operations in trench area Keep work area free of trip hazards Perform necessary soil classification Use hearing protection as necessary Wear designated PPE and conduct air monitoring 	CRA Construction Oversight Person
3	Excavation entry activities (if required)	<ul style="list-style-type: none"> Soil cave-in Struck-by/against hazards Hazardous atmospheres Slip/trip/fall hazards Emergency egress 	<ul style="list-style-type: none"> Keep proper distances from edge of excavation Limit equipment operations in trench area Keep work area free of trip hazards Perform necessary soil classification Use daily inspection form to document/meet competent person inspection requirements Inspect trench after any change in conditions (rain, equipment vibrations, etc.) Provide fall protection measures Utilize shoring equipment properly – ensure that tabulated data sheet is on site Use 4-gas monitor and PID to screen excavation air prior to and during entry Ladder safety and proper slope of ladder Use harness and lifeline when entering trenches over 5 feet deep 	CRA Construction Oversight Person



JOB SAFETY ANALYSIS (JSA)

Excavation Oversight



- (1) Each Job or Task consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the potential (associated) hazards.
- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".



JOB SAFETY ANALYSIS (JSA)

Heavy Equipment Operation – Hydraulic Track Excavator



Safety Means Awareness
Responsibility Teamwork

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Construction
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Hydraulic Track Excavator		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Hydraulic excavator (appropriately sized);		
Task-specific Training:	Heavy Equipment Operation; HASP; OQ training		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input checked="" type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input checked="" type="checkbox"/> Other* Fire Extinguisher		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Heavy Equipment Operation – Hydraulic Track Excavator



Safety Means Awareness
Responsibility Teamwork

Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Discuss STAR and SWA	<ul style="list-style-type: none"> Failing to identify hazardous conditions resulting in losses or near losses 	<ul style="list-style-type: none"> Determine the hazards of performing the task and survey the work area Consider weather conditions such as fog that could reduce visibility Always consider the worst-case scenario Analyze the hazards determined Decide a plan of action to eliminate or reduce the hazards and act on it 	Site Supervisor on all
2	Inspect equipment	<ul style="list-style-type: none"> Equipment malfunction or damage Hydraulic fluid, fuel, oil leaks/spills Loss of steering, loss of brakes, etc.; accidents, decreased visibility Fire Slip/trip/fall hazards Unexpected operation of equipment Swing radius signage missing 	<ul style="list-style-type: none"> Follow CRA Equipment Inspection Form/Tag Out if malfunction found Grease moving parts Check all fluids Ensure that fluids are not too low or too full Walk around equipment and look for leaking fluids Ensure that tracks are acceptable (no unacceptable wear and no objects present) Ensure that windows and mirrors are clean. Adjust mirrors! Remove trash or other debris from cab Ensure that back up alarm and horn are operational Correct any problems immediately and inform supervisor If equipment appears as though it has been tampered with or vandalized, do not start it Ensure that fire extinguisher is in place and functioning Inspect the fire extinguisher monthly Use three point mount/dismount at all times Be cautious of where you step and be aware of your surroundings Ensure that ignition key is in your pocket, equipment is in neutral and parking brake is engaged Use interlock safety mechanism any time equipment is not conducting a productive and/or controlled activity 	Site Supervisor and Operator
3	Entering equipment	<ul style="list-style-type: none"> Reduced visibility Uncomfortable seating - back strain Debris on floor getting stuck under pedals Unexpected movement of excavator 	<ul style="list-style-type: none"> Adjust seat and mirrors so that you are able to see where traveling Adjust controls and seat to your comfort and safety Ensure that all materials inside cab are secured Be cautious of where you step and be aware of your surroundings Ensure steps are clear of water, mud, and other debris Ensure parking brake is engaged and gear is in neutral Use interlock safety mechanism any time equipment is not conducting a productive and/or controlled activity 	Site Supervisor and Operator
4	Configure controls and seating	<ul style="list-style-type: none"> Ergonomics/unnecessary physical stress/back injury Incapable of reaching controls Visual blocks 	<ul style="list-style-type: none"> Upon sitting, adjust seat fully to accommodate reach and comfort zone Fasten seat belt Make certain all controls are set in neutral positions Adjust mirrors 	Site Supervisor and Operator
5	Starting and warming up	<ul style="list-style-type: none"> Unanticipated rolling or movement, engine fire, or mechanical/electrical faults 	<ul style="list-style-type: none"> Review operator's manual if new to this particular machine Start engine and check controls to ensure all are in working conditions Allow a minimum of 2 minutes to warm up 	Site Supervisor and Operator



JOB SAFETY ANALYSIS (JSA)

Heavy Equipment Operation – Hydraulic Track Excavator



Safety Means Awareness
Responsibility Teamwork

Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
6	Moving equipment work area	<ul style="list-style-type: none">Other equipment, personnel, or objects in work areaUneven terrain	<ul style="list-style-type: none">Perform STAR – be aware of surroundingsKnow the daily task and other people and equipment in the areaMake eye contact with other operators and site personnel in the immediate vicinityInspect pathway prior to moving equipment to ensure clear pathway	Site Supervisor and Operator
7	Performing tasks	<ul style="list-style-type: none">Other equipment (collision)Slopes, ground conditions possible injuries to personnel and equipment, buried obstacles, underground and overhead utilitiesDust	<ul style="list-style-type: none">Perform STARKnow where utilities are located – know where your bucket is in relation to any underground utilities at all timesBe aware of the scope of work to be performedUse a spotterKnow the paths of other equipment or persons entering and leaving your work areaCommunicate with supervisors and other operators throughout the day with any questionsStop work immediately and contact a supervisor if you are uncertain of your task, experience equipment failure, or personal injury or near lossWear dust mask if conditions warrant	Site Supervisor and Operator
8	Stopping at end of day	<ul style="list-style-type: none">Slip/trip/fall hazardsOvernight parking of equipment	<ul style="list-style-type: none">Be cautious of where you step and be aware of your surroundingsPark in designated areaSet brake/control locksIdle for 2 minutes if engine is hotLower bucket to ground – zero energy stateTurn equipment off; remove keysUse three-point dismountSecure inside instruments (i.e., fire extinguisher)	Site Supervisor and Operator

- (1) Each Job or Task consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the potential (associated) hazards.
- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".



JOB SAFETY ANALYSIS (JSA)

Loading Soil with Excavator



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2008	JSA Type:	[Construction/Office Work/O&M/Drilling/Maintenance/Demolition/Decommissioning]
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Loading soil with excavator		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Excavator		
Task-specific Training:	Heavy equipment operation and safety		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input checked="" type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input checked="" type="checkbox"/> Other* Photoionization detector (PID)		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Modified Level D (MLD) PPE

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Loading Soil with Excavator



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Inspect work area	<ul style="list-style-type: none">Slip/trip/fall hazardsBiological hazards	<ul style="list-style-type: none">Clear any hazards that are clearableMark major obstructions with orange tapeExercise cautionPay close attention to the ground surfaceInspect immediate surroundingsWalk cautiously	Equipment Operator
2	Inspect equipment	<ul style="list-style-type: none">Slip/trip/fall hazardsdamage to equipment or self if there is undetected equipment damage	<ul style="list-style-type: none">Use three points of contactFollow intact equipment inspection formParking brake should be engaged and key in pocketMaintain a three-point mount/dismountCorrect any matters immediately and/or report to supervisor	Equipment Operator
3	Establish communication	<ul style="list-style-type: none">Know response for emergencies and accidents	<ul style="list-style-type: none">Hand and horn signals establishedEmergency signal established	Equipment Operator
4	Begin excavation	<ul style="list-style-type: none">Equipment damagePeople/hazards in swing radius slidesCave-ins	<ul style="list-style-type: none">All operators must be trained, skilled, and experiencedOperator must look around area and be aware of surroundings at all timesUse proper sloping/shoring techniquesKeep excavator on even or undisturbed surfaces	Equipment Operator
5	Excavator loads soil into truck	<ul style="list-style-type: none">Truck running into excavatorTipping over	<ul style="list-style-type: none">Operators have stopping signal (two honks)Awareness of surroundingsDo not overload truck or bucket to avoid spillageSpread the soil in the truck bed to avoid having one side heavier than the otherTrucks need to remain on level ground	Equipment Operator

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- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".



JOB SAFETY ANALYSIS (JSA)

Material Handling



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Construction
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Lifting and Rigging: Placement of concrete or steel components, pipe, vaults, or manhole rings and lids		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Excavator, or backhoe		
Task-specific Training:	Rigging; lifting signals; heavy equipment safety; use of taglines; proper use of load charts		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Leather gloves

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Material Handling



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Equipment Inspection	<ul style="list-style-type: none">Hydraulic failure	<ul style="list-style-type: none">Inspect equipment lines and fluid reservoirs	Operator
2	Rigging components – inspection of load and rigging	<ul style="list-style-type: none">Attachment point failure	<ul style="list-style-type: none">Inspect attachment hook/ring for fractures, dents, or abuseCertify load capability of attachment point	Operator, Qualified Rigger, and Superintendent
3	Rigging components – continue inspection of load, rigging, and material to be lifted	<ul style="list-style-type: none">Rigging assembly failure	<ul style="list-style-type: none">Inspect rigging chains, wire rope, cables, hooks, slings, d-rings, splitters, spreaders, and all other components for unusual shape, fractures, fraying, dents, abuse, or abnormalitiesEnsure components used have annual certification, proper load rating and are implemented as recommended by training and manufacturer	Operator, Laborer, Site Superintendent, and all field personnel involved in operation
4	Rigging components	<ul style="list-style-type: none">Improper component attachmentImproper lifting point usageincorrect balance or component orientation	<ul style="list-style-type: none">Use manufacturer's recommended lifting attachment points, slots, or cable points to secure load to be riggedUse proper rigging components to assure load is evenly distributed, proper balance is achieved, and place hoisting equipment and rigged components in proper orientation to assure placement logistics are correct	Operator, Laborer, Site Superintendent, and all field personnel involved in operation
5	Tag lines – proper placement of taglines to ensure control of load. No one is to work under a suspended load.	<ul style="list-style-type: none">Lift control failure	<ul style="list-style-type: none">Use of tag lines as a lifting control measure is mandatory as appropriate for correct placement of rigged componentPersonnel assisting rigging or lift should never physically be in contact with rigged or lifted components as a measure of component control	Operator, Laborer, Site Superintendent, and all field personnel involved in operation
6a	Pre-plan the lift and prepare the landing zone	<ul style="list-style-type: none">Objects/personnel in swing radius pathLifting outside of equipment's load safe load radius	<ul style="list-style-type: none">Pre-plan the lift to ensure swing radius does not impact other operationsEnsure that load and load path stays within load radius of lifting equipment	Superintendent, Rigger, and Operator
6b	Component placement – pick the load and place the item in the correct position	<ul style="list-style-type: none">Improper preparation of location receiving rigged or lifted component resulting in need for multiple lifts	<ul style="list-style-type: none">Preparation of the area receiving the rigged or lifted component to avoid and necessary re-lift or multiple lifts	Operator, Laborer, Site Superintendent, and all field personnel involved in operation
7	Maintain control of area	<ul style="list-style-type: none">Unauthorized personnel or equipment in rigging or lifting exclusion zone	<ul style="list-style-type: none">Area marking and clearance of all personnel and equipment to prevent interference during rigging or lifting activitiesSpotter action to terminate rigging or lifting if situational changes occur putting personnel or equipment at risk	Operator, Laborer, Site Superintendent, and all field personnel involved in operation
8	Control of communication between task personnel	<ul style="list-style-type: none">Multiple signals interfering with operator	<ul style="list-style-type: none">During lifting or rigging activities, a communication order must be established previous to any attempt to hoist loadSpotters communicate to one load controller, load controller communicates to operatorOperator must maintain visual contact with load controller at all timesAll operations are controlled by ground controller	Operator, Laborer, Site Superintendent, and all field personnel involved in operation

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- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".



JOB SAFETY ANALYSIS (JSA)

Silt Fence Installation - Impacted Soil



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Construction
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Silt fence installation using hand tools and hydraulic excavator in mercury (Hg) impacted soils		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Backhoe and/or fence post driver, hand shovel, ground labor, dust monitor, Jerome mercury (hg) vapor monitor		
Task-specific Training:	Hand Tools; Heavy Equipment Safety; Air Monitoring Instruments		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*		<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input checked="" type="checkbox"/> Other* Insect Repellant		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Stout leather gloves to prevent hand injuries protected by nitrile gloves to keep mercury-impacted soils from permeating leather gloves.

Mandatory half or full face respirator usage during Hg handling activities with Mersorb cartridge for Hg cartridges; spent PPE to be disposed of in accordance with Project Manager's instructions.

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Silt Fence Installation - Impacted Soil



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Equipment inspection	<ul style="list-style-type: none"> Hydraulic failure Instrument/monitor failure 	<ul style="list-style-type: none"> Inspect equipment lines and fluid reservoirs; document inspection Calibrate instrument prior to use; document calibration 	Operator
2	Underground utilities	<ul style="list-style-type: none"> Impact, breach, or rupture of underground utilities 	<ul style="list-style-type: none"> Inspect area Call underground utility locator and monitor locator during locating activities Ask questions Use CRA Underground Utility Clearance Form and verify all markings, locations, and procedures prior to installation work 	Operator, Laborer, Superintendent, and all field personnel involved in operation
3	Installation zone inspection	<ul style="list-style-type: none"> Underground insects/hives Poisonous plants Stinging/biting insects Chemical hazards 	<ul style="list-style-type: none"> Visually inspect area of fence installation for any activity regarding hornets, yellow jackets, bees, fire ants, or termites A slow walk or drive along the fence path prior to excavation to inspect for insects flying in and out of ground, ant humps or mounds, and trails Stop work if free product (mercury droplets) is encountered 	Operator, Laborer, Superintendent, and all field personnel involved in operation
4	Silt fence trough (pathway) excavation	<ul style="list-style-type: none"> Struck-by/against Utilities Chemical hazards Cross-contamination 	<ul style="list-style-type: none"> Setup safe work area Use a spotter when moving equipment Use a spotter when digging to assist with observing for underground installations Spotter will be used when working near overhead lines to assist equipment operator and keep machine away/out of lines Wear appropriate PPE (coveralls, respirator with Mersorb cartridges, gloves, boots) when excavating/working in Hg impacted soils Use air monitoring instruments properly Determine background levels and if background levels for dust and Hg vapor are exceeded call Project Manager and Regional Safety and Health Manager for additional information Control areas where excavator will travel Attempt to keep excavator tires out of impacted spoils and areas Employees are to setup work area access to minimize spread of contamination 	Operator, Laborer, Superintendent, and all field personnel involved in operation
5	Hand tool use	<ul style="list-style-type: none"> Improper hammer/tool selection Stapler use; cuts/abrasions Chemical hazards 	<ul style="list-style-type: none"> Use only a hammer of a weight and handle length appropriate to individual laborer's capability Inspect every post and hammer for signs of metal fatigue/fractures Inspect stapler for correct staple installation Inspect stapler and test operation for gauging correct drive pressure Use staples of a length needed for the job Safety glasses and awareness of installer hand location during use of a hammer or staple gun Ensure that all hand tools (fence post driver, shovel, etc.) are in good working condition Wear proper PPE such as stout leather gloves to prevent trauma to hands; don coveralls, boots, and respirator when working in Hg impacted area Use work practices that do not generate visible dust levels Use dust monitor and Jerome mercury vapor monitor to determine levels of Hg present in the worker's breathing zone Use air monitoring instruments properly Determine background levels and if background levels for dust and Hg vapor are exceeded call Project Manager and Regional Safety and Health Manager for additional information 	Operator, Laborer, Superintendent, and all field personnel involved in operation



JOB SAFETY ANALYSIS (JSA)

Silt Fence Installation - Impacted Soil



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
6	Fence layout activities	<ul style="list-style-type: none">Back or muscle strain	<ul style="list-style-type: none">Use the buddy system during silt fence installation100-foot fence rolls require a coordinated two-man effort to place fence correctly and according to manufacturer's requirements	
7	Cleaning of machine bucket	<ul style="list-style-type: none">Chemical hazard	<ul style="list-style-type: none">Wear appropriate PPE (coveralls, boots, respirator, and gloves) to prevent contact with impacted soils	

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JOB SAFETY ANALYSIS (JSA)

Trenching/Excavating with Backhoe



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Construction
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Excavation activities – backhoe		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Backhoe		
Task-specific Training:	Heavy Equipment Safety		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input checked="" type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Trenching/Excavating with Backhoe



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Set up traffic and site control	<ul style="list-style-type: none"> Struck-by traffic hazards 	<ul style="list-style-type: none"> Refer to Traffic Control Plan and HASP Use buddy system when placing traffic control devices Always face traffic 	Site Personnel
2	Site preparation (includes air monitoring, excavation layout, inspect work area, etc.)	<ul style="list-style-type: none"> Chemical hazard Overhead/underground installations Biological hazards 	<ul style="list-style-type: none"> Follow air monitoring program in HASP Inspect work area for utilities, biological hazards, traffic hazards, off-site receptors Ensure One-Call Locate ticket number is current, QSF-019 is complete, and that all other relevant utility locate actions have been completed 	Site Personnel
3a	Position/set up backhoe	<ul style="list-style-type: none"> Pedestrian and vehicular traffic Slip/trip/fall hazards Existing/overhead structures 	<ul style="list-style-type: none"> Always use a spotter to direct backhoe into position Set outriggers and make sure ground is solid; avoid soft terrain Set up exclusion work zone with traffic barricades and signage to secure work area Be aware of the height restrictions of the equipment Make sure work area remains clean and organized 	Site Personnel
3b	Inspect backhoe and surrounding area	<ul style="list-style-type: none"> Hydraulic line failure pedestrian struck by equipment or debris Release to environment 	<ul style="list-style-type: none"> Visually inspect all components of equipment, no oil/fluid leaks, tires properly inflated, fluid levels and associated equipment in good condition Replace worn or damaged hoses Ensure barricades/work zone is setup to protect public 	Site Personnel
4	Prepare surface for excavation activities: cut pavement at location (as necessary), etc.	<ul style="list-style-type: none"> Moving blade Eye hazards Exhaust from motor Dust inhalation Noise – hearing impairment Back strain Traffic hazards 	<ul style="list-style-type: none"> Wear face shield, gloves, ear plugs or muffs, control dust with water or wear dust mask Employ proper lifting techniques or mechanical assistance Keep work area clear of debris Use buddy system or spotter when possible Maintain traffic control and face oncoming traffic Refer to TCP and/or HASP 	Site Personnel
5	Backhoe operation	<ul style="list-style-type: none"> Hitting an underground or overhead utility/structure Flying debris COC exposure Noise - hearing impairment Dust inhalation Back strain Traffic hazards Heat/cold stress Slip/trip/fall hazards 	<ul style="list-style-type: none"> Wear all required PPE by HASP Initiate air monitoring as necessary Watch overhead clearance at all times, use spotters as necessary Be aware of the height restrictions of the equipment Only those workers wearing proper PPE should be allowed near the excavation while backhoe is operating Use proper lifting techniques Ensure work area remains clean and organized Take breaks as necessary or as indicated in the HASP to avoid back strain (repetitive/vibration ergo issues and heat/cold stress) Perform periodic visual inspection of equipment Maintain traffic control and face oncoming traffic 	Site Personnel
6	Backfill cleared excavations and mark cleared locations	<ul style="list-style-type: none"> Back strain Eye injury COC exposure Slip/trip/fall hazards Struck-by hazards 	<ul style="list-style-type: none"> Use proper lifting techniques Make sure work area remains clean and organized Clearly mark cleared locations with a permanent method (e.g., paint, stakes) Map cleared locations, site structures, and location of wastes Keep clear of swing radius; demarcate safe work area/zone 	Site Personnel



JOB SAFETY ANALYSIS (JSA)

Trenching/Excavating with Backhoe



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
7	Site cleanup	<ul style="list-style-type: none">• Slip/trip/fall hazards• Back strain	<ul style="list-style-type: none">• Use proper lifting techniques• Make sure work area remains clean and organized• Use buddy system, if possible, to remove traffic controls• Leave site clean of debris and refuse	Site Personnel

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JOB SAFETY ANALYSIS (JSA)

Decontamination of Sampling Equipment and Personnel (PPE Level D)



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Decontamination
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Decontamination of sampling equipment and personnel (PPE Level D)		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Alconox/Liquinox, brushes, [special chemicals or additional equipment?]		
Task-specific Training:	Decontamination/Site Control; Quality Control/Sampling Plan		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Nitrile gloves to be worn when decontaminating reusable equipment

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Decontamination of Sampling Equipment and Personnel (PPE Level D)



Safety Means Awareness
Responsibility Teamwork

Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Decontamination of sampling equipment to include pumps, bailers, tubing, etc.	<ul style="list-style-type: none">Contaminant exposurePinch pointsSlip/trip/hit/fall hazardsHeavy lifting	<ul style="list-style-type: none">Wear appropriate PPE during decon activities (nitrile gloves)Avoid putting hands in or near pinch pointsMaintain good housekeeping, be aware of surroundingsUse proper lifting techniques, buddy lift when appropriate	Sampling personnel
2	Decontamination of personnel	<ul style="list-style-type: none">Contaminant exposureSlip/trip/hit/fall hazards	<ul style="list-style-type: none">Dispose of used PPE in accordance with site requirementsWash hands and face before eating, drinking, or using tobacco productsTake care when removing PPE (boots, gloves, etc.). Sit down to remove/change boots as necessary	Sampling personnel
3	Management of waste derived from decontamination activities	<ul style="list-style-type: none">Contaminant exposureHeavy lifting	<ul style="list-style-type: none">Containerize decon waste (water, used PPE, etc) as requiredUse proper lifting techniques, use buddy lifting or mechanical means when necessary	Sampling personnel

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- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
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JOB SAFETY ANALYSIS (JSA)

Soil Sampling



Safety Means Awareness
Responsibility Teamwork

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Drilling, Soil Sampling
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Soil sampling		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Air monitoring equipment, PPE		
Task-specific Training:	CRA Field Method Training on Soil Sampling Procedures		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input type="checkbox"/> Hearing Protection*	<input checked="" type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Tyvek if Level C initiated; gloves dependent on the task and chemical contamination present or suspected present

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Soil Sampling



Safety Means Awareness
Responsibility Teamwork

Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Discuss STAR and SWA	<ul style="list-style-type: none"> Site personnel not aware of STAR and SWA 	<ul style="list-style-type: none"> Project team (CRA) discusses importance of and documentation procedures for SWA during pre-job safety meeting Use SWA to stop any work that is unsafe 	Site Personnel
2	Inspect and calibrate sampling and monitoring equipment	<ul style="list-style-type: none"> Lost time from improperly functioning equipment Incorrect sampling procedures/collection due to malfunctioning equipment 	<ul style="list-style-type: none"> Ensure all equipment is functioning properly Complete Quality Control documents 	Sampling Technician
3	Prepare to collect soil samples	<ul style="list-style-type: none"> Back strain Pinch points Cuts Punctures Sample misidentification 	<ul style="list-style-type: none"> Use proper lifting techniques and buddy system if needed Avoid placing hands/fingers in pinch point locations Use proper tools when opening container packaging Do not use fixed open blade knives when opening boxes or containers Ensure the sample id label matches sample location with site plan/CRA site supervisor/subcontractor 	Sampling Technician
4	Opening the sample sleeve (if applicable)	<ul style="list-style-type: none"> Cuts due to sharp edges of sample sleeve Contaminant exposure 	<ul style="list-style-type: none"> Use sleeve cutter for opening the sample sleeves Keep hands clear of the sleeve when cutting Wear nitrile gloves Maintain awareness of sharp edges of sample sleeve 	Sampling Technician
5	Sample collection	<ul style="list-style-type: none"> Contaminant exposure Cuts from container breakage Sample misidentification 	<ul style="list-style-type: none"> Wear nitrile gloves and replace between soil samples Inspect glass bottles for breaks/cracks Do not attempt to use any suspect containers Close glass sample containers carefully to avoid breakage Check sample labels for accuracy prior to placing in cooler 	Sampling Technician
6	Headspace screening of samples	<ul style="list-style-type: none"> Contaminant exposure Incorrect headspace readings 	<ul style="list-style-type: none"> Wear nitrile gloves Ensure proper calibration of equipment 	Sampling Technician
7	Sample selection	<ul style="list-style-type: none"> Bottle breakage Contaminant exposure Pinch points Lost time due to incorrect sample selection 	<ul style="list-style-type: none"> Wear nitrile gloves when handling sample containers Confirm selected samples are correct based on work plan selection criteria, PID readings, and soil boring logs Avoid placing hands/fingers in pinch point locations (e.g., between cooler and lid) 	Sampling Technician
8	Packing samples in cooler(s)	<ul style="list-style-type: none"> Bottle breakage Contaminant exposure Cuts Pinch points Back strain Lost time due to incorrect sample packaging or hold time exceedances 	<ul style="list-style-type: none"> Wear nitrile gloves when handling sample containers Pack glass containers in bubble wrap Check COC against sample labels and SSOW for accuracy before shipping Avoid placing hands/fingers in pinch point locations (e.g., between cooler and lid) Use proper lifting techniques and buddy system if needed Ensure equipment and supplies are loaded correctly and do not shift during transport 	Sampling Technician



JOB SAFETY ANALYSIS (JSA)

Soil Sampling



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
9	Investigation derived waste (IDW) management	<ul style="list-style-type: none">Contaminant exposureHeavy liftingPinch pointsSlips/trips/fall hazardsMislabeled waste	<ul style="list-style-type: none">Wear nitrile gloves when handling IDWUse proper lifting techniques to transport/dispose of IDW into drums and use buddy system if neededAvoid placing hands/fingers in pinch point locationsMaintain awareness of walking surfacesLabel IDW with generator, a contact number, identification of contents, and site locationSpecify IDW as either hazardous or non-hazardous material	Sampling Technician

- (1) Each Job or Task consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the potential (associated) hazards.
- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".



JOB SAFETY ANALYSIS (JSA)

Mobilization-Demobilization



Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each workday. **Stop, Think, Act, Review (STAR)** must be used prior to any activity. All personnel must possess the appropriate training prior to initiating scheduled tasks. Also consider weather conditions. CRA personnel have the authority and responsibility to use **Stop Work Authority (SWA)**.

Date Issued/Revised:	January 28, 2009	JSA Type:	Mobilization/Demobilization
Work Type:	Remediation	Client:	Sidley and Austin Law Firm
Work Activity:	Soil Excavation, removal, in-situ stabilization, and confirmatory sampling		
Work Site:	20 Jefferson Avenue, Elgin, IL		
Key Equipment:	Backhoe, ice, coolers, cement		
Task-specific Training:	HAZWOPER, Heavy equipment operation and safety, CRA Field Methods Training-Soil Sampling		

MINIMUM REQUIRED PERSONAL PROTECTIVE EQUIPMENT (see job steps for task-specific requirements)

<input checked="" type="checkbox"/> Reflective Vest	<input type="checkbox"/> Goggles	<input checked="" type="checkbox"/> Gloves*	Supplied Air	APR	
<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Face Shield*	<input type="checkbox"/> Coveralls*	<input type="checkbox"/> SCBA	<input type="checkbox"/> Full Face APR	<input checked="" type="checkbox"/> Particulate <input type="checkbox"/> Organic Vapor
<input type="checkbox"/> Lifeline/Harness*	<input checked="" type="checkbox"/> Hearing Protection*	<input type="checkbox"/> PPE Clothing*	<input type="checkbox"/> Airline Respirator (attach description)	<input type="checkbox"/> Half Mask APR	<input type="checkbox"/> Particulate/Organic Vapor Combined
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety-toed Boots				<input type="checkbox"/> Acid Gas
<input type="checkbox"/> Other*		<input type="checkbox"/> Other*		<input type="checkbox"/> Other*	

ADDITIONAL PPE (*provide specific type(s) or descriptions of this item below)

Nitrile gloves

Project Development Team		Position/Title	Modified By	Reviewed By	Position/Title	Date
Name	Signature					
Michael Richie		Engineer A2				



JOB SAFETY ANALYSIS (JSA)

Mobilization-Demobilization



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
1	Discuss STAR and SWA	<ul style="list-style-type: none"> Site personnel not aware of STAR and SWA 	<ul style="list-style-type: none"> Project team (CRA) discusses importance of and documentation procedures for SWA during pre-job safety meeting Use SWA to stop any work that is unsafe 	Site Personnel
2	Check weather	<ul style="list-style-type: none"> Unexpected storm Fog; rain; snow; lightening/thunder Heat/cold stress 	<ul style="list-style-type: none"> Check local weather forecast Discuss weather issues and precautions to take while driving and on site during the pre-job safety meeting If weather conditions (e.g., fog, rain, snow, etc.) impair the ability/vision of the driver, exit at nearest safe location and assess the situation While on site, at first sign of lightening/thunder utilize SWA and assess weather conditions In extreme temperatures, ensure all personnel have proper clothing, hydration, and heat/cold protection (e.g., canopy, fan, glove warmers) 	Site Personnel
3	Load equipment into vehicle	<ul style="list-style-type: none"> Back strain Cuts Pinch points Hand/foot injury Forgotten or damaged equipment 	<ul style="list-style-type: none"> Use proper lifting techniques and buddy system if needed Wear leather/cotton gloves and avoid placing hands/fingers in pinch point locations Wear safety-toed boots Verify requested equipment against warehouse form Load equipment in an organized manner to prevent shifting during transport or use cargo netting 	Site Personnel
4	Complete CRA Daily Operator Vehicle Checklist	<ul style="list-style-type: none"> Damaged vehicle lights, tires, windows, mirrors, horn Inadequate vehicle documents and/or safety items 	<ul style="list-style-type: none"> Check for fluid leaks under vehicle Test operation of headlights, front/rear turn signals, backup lights, brake lights, and emergency flashers Visually check the pressure/wear of tires Ensure the vehicle has a spare tire Assure windshield and window glass is clean and free from obstructions Test the windshield wipers and horn Verify vehicle registration, insurance card, and inspection sticker is present and valid Ensure the vehicle contains a first aid kit, fire extinguisher, and road hazard kit 	Site Personnel
5	Check and adjust seat, steering wheel, headrest, and mirrors	<ul style="list-style-type: none"> Back/body strain Blind spot Impaired vision 	<ul style="list-style-type: none"> Adjust seat, headrest, and steering wheel height so body is fully supported/comfortable and pedals are within easy reach Ensure mirrors are properly adjusted 	Site Personnel
6	Fasten seat belt(s) and ensure passenger(s) seat belts are fastened	<ul style="list-style-type: none"> Serious injury, ejection, or death from collision and/or traffic citation 	<ul style="list-style-type: none"> Verify driver and passenger(s) seat belts are in good condition and properly latched 	Site Personnel



JOB SAFETY ANALYSIS (JSA)

Mobilization-Demobilization



Job Steps ⁽¹⁾	Task Activity	Potential Hazard(s) ⁽²⁾	Corrective Measure(s) ⁽³⁾	Person Responsible
7	Ensure vehicle doors are locked	<ul style="list-style-type: none">• Serious injury, ejection, or death from collision• Unwanted intrusion• Lost equipment	<ul style="list-style-type: none">• Manually lock all doors to vehicle	Site Personnel
8	Start engine and check gauges and warning lights	<ul style="list-style-type: none">• Vehicle breakdown	<ul style="list-style-type: none">• Verify sufficient fuel and other hazard lamps (e.g., battery, oil, and temperature) are not lit	Site Personnel
9	Mobilize to site	<ul style="list-style-type: none">• Arriving late• Collision• Injury or death to occupants or other parties	<ul style="list-style-type: none">• Do not use cell phones or perform other distracting activities while vehicle is in motion• Constantly scan intersections, move eyes, check mirrors, and assess traffic lights (fresh vs. stale)• Maintain safety cushion around vehicle (front, sides, and rear) and 4-second following distance• Utilize all driving defensive techniques	Site Personnel
10	Arrive at site	<ul style="list-style-type: none">• Pedestrian injury• Collision	<ul style="list-style-type: none">• Maintain awareness of pedestrian/vehicular traffic when entering site and traveling to work zone	Site Personnel
11	Park vehicle	<ul style="list-style-type: none">• Pedestrian injury• Collision• Property damage	<ul style="list-style-type: none">• Maintain awareness of pedestrian/vehicular traffic• Park vehicle in pull-through parking space or facing the exit• Use caution and mirrors/spotter when backing vehicle	Site Personnel
12	Demobilization	<ul style="list-style-type: none">• Collision• Injury or death to occupants or other parties	<ul style="list-style-type: none">• Perform perimeter vehicle check• Maintain awareness of pedestrian/vehicular traffic when exiting site• Utilize defensive driving techniques• Complete post-departure checklist and report vehicle problems to company vehicle maintenance manager or rental car agency	Site Personnel

- (1) Each Job or Task consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the potential (associated) hazards.
- (2) A hazard is a potential danger. What can go wrong? How can someone get hurt? Consider, but do not limit, the analysis to: **Contact** - victim is struck by or strikes an object; **Caught** - victim is caught on, caught in or caught between objects; **Fall** - victim falls to ground or lower level (includes slips and trips); **Exertion** - excessive strain or stress/ergonomics/lifting techniques; **Exposure** - inhalation/skin hazards. Specify the hazards and do not limit the description to a single word such as "Caught".
- (3) Aligning with the Job Steps, Task Activity Description, and Potential Hazard columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable, and quantified terms. Avoid subjective general statements such as "be careful" or "use as appropriate".

APPENDIX C

MATERIAL SAFETY DATA SHEETS



Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Lead MSDS

Section 1: Chemical Product and Company Identification

Product Name: Lead

Catalog Codes: SLL1291, SLL1669, SLL1081, SLL1459, SLL1834

CAS#: 7439-92-1

RTECS: OF7525000

TSCA: TSCA 8(b) inventory: Lead

CI#: Not available.

Synonym: Lead Metal, granular; Lead Metal, foil; Lead Metal, sheet; Lead Metal, shot

Chemical Name: Lead

Chemical Formula: Pb

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Lead	7439-92-1	100

Toxicological Data on Ingredients: Lead LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (permeator).

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC.

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to blood, kidneys, central nervous system (CNS).

Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Non-flammable in presence of open flames and sparks, of shocks, of heat.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

SMALL FIRE: Use DRY chemical powder.

LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes of lead.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 0.05 (mg/m³) from ACGIH (TLV) [United States]

TWA: 0.05 (mg/m³) from OSHA (PEL) [United States]

TWA: 0.03 (mg/m³) from NIOSH [United States]

TWA: 0.05 (mg/m³) [Canada] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 207.21 g/mole

Color: Bluish-white. Silvery. Gray

pH (1% soln/water): Not applicable.

Boiling Point: 1740°C (3164°F)

Melting Point: 327.43°C (621.4°F)

Critical Temperature: Not available.

Specific Gravity: 11.3 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, excess heat

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Can react vigorously with oxidizing materials.

Incompatible with sodium carbide, chlorine trifluoride, trioxane + hydrogen peroxide, ammonium nitrate, sodium azide, disodium acetylide, sodium acetylide, hot concentrated nitric acid, hot concentrated hydrochloric acid, hot concentrated sulfuric acid, zirconium.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.

LC50: Not available.

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC.

May cause damage to the following organs: blood, kidneys, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:

Acute Potential:

Skin:

Lead metal granules or dust: May cause skin irritation by mechanical action.

Lead metal foil, shot or sheets: Not likely to cause skin irritation

Eyes:

Lead metal granules or dust: Can irritate eyes by mechanical action.

Lead metal foil, shot or sheets: No hazard. Will not cause eye irritation.

Inhalation:

In an industrial setting, exposure to lead mainly occurs from inhalation of dust or fumes.

Lead dust or fumes: Can irritate the upper respiratory tract (nose, throat) as well as the bronchi and lungs by mechanical action. Lead dust can be absorbed through the respiratory system. However, inhaled lead does not accumulate in the lungs. All of an inhaled dose is eventually absorbed or transferred to the gastrointestinal tract. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include metallic taste, chest pain, decreased physical fitness, fatigue, sleep disturbance, headache, irritability, reduces memory, mood and personality changes, aching bones and muscles, constipation, abdominal pains, decreasing appetite. Inhalation of large amounts may lead to ataxia, delirium, convulsions/seizures, coma, and death.

Lead metal foil, shot, or sheets: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count.

Ingestion:

Lead metal granules or dust: The symptoms of lead poisoning include abdominal pain or cramps (lead colic), spasms, nausea, vomiting, headache, muscle weakness, hallucinations, distorted perceptions, "lead line" on the gums, metallic taste, loss of appetite, insomnia, dizziness and other symptoms similar to that of inhalation. Acute poisoning may result in high lead levels in the blood and urine, shock, coma and death in extreme cases.

Lead metal foil, shot or sheets: Not an ingestion hazard for usual industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Lead

California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Lead

California prop. 65: This product contains the following ingredients for which the State of California has found to

cause reproductive harm (male) which would require a warning under the statute: Lead
California prop. 65 (no significant risk level): Lead: 0.0005 mg/day (value)
California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Lead
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Lead
Connecticut hazardous material survey.: Lead
Illinois toxic substances disclosure to employee act: Lead
Illinois chemical safety act: Lead
New York release reporting list: Lead
Rhode Island RTK hazardous substances: Lead
Pennsylvania RTK: Lead

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R20/22- Harmful by inhalation and if swallowed.
R33- Danger of cumulative effects.
R61- May cause harm to the unborn child.
R62- Possible risk of impaired fertility.
S36/37- Wear suitable protective clothing and gloves.
S44- If you feel unwell, seek medical advice (show the label when possible).
S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:21 PM

Last Updated: 10/10/2005 08:21 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.



New Jersey Department of Health and Senior Services

HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **POLYCHLORINATED
BIPHENYLS**

CAS Number: 1336-36-3
DOT Number: UN 2315

RTK Substance number: 1554
Date: April 1996 Revision: April 2002

HAZARD SUMMARY

- * **Polychlorinated Biphenyls** can affect you when breathed in and by passing through your skin.
- * **Polychlorinated Biphenyls** are CARCINOGENS--HANDLE WITH EXTREME CAUTION.
- * **Polychlorinated Biphenyls** can affect the reproductive system of adults.
- * **Polychlorinated Biphenyls** can irritate and burn the eyes.
- * Exposure to the vapor can irritate the nose and throat causing cough and/or difficulty breathing.
- * **Polychlorinated Biphenyls** can cause nausea, vomiting, loss of weight and stomach pain.
- * **Polychlorinated Biphenyls** may cause an acne-like rash (chloracne) following skin contact, which may persist for years.
- * High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles") in the arms and legs.
- * **Polychlorinated Biphenyls** may cause liver damage.

IDENTIFICATION

Polychlorinated Biphenyls are mixtures of chemicals that form clear to yellow, oily liquids or white, crystalline (sand-like) solids and hard resins. They are used in insulating fluids of electrical systems.

REASON FOR CITATION

- * **Polychlorinated Biphenyls** are on the Hazardous Substance List because they are regulated by OSHA and cited by ACGIH, DOT, NIOSH, NTP, DEP, IARC, HHAG and EPA.
- * These chemicals are on the Special Health Hazard Substance List because they are **CARCINOGENS**.
- * Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard, 1910.1200, requires private employers to provide similar training and information to their employees.

- * Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under OSHA 1910.1020.
- * If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.

WORKPLACE EXPOSURE LIMITS

OSHA: The legal airborne permissible exposure limit (PEL) is **1 mg/m³** (42% *Chlorine*) and **0.5 mg/m³** (54% *Chlorine*) averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is **0.001 mg/m³** averaged over a 10-hour workshift.

ACGIH: The recommended airborne exposure limit is **1 mg/m³** (42% *Chlorine*) and **0.5 mg/m³** (54% *Chlorine*) averaged over an 8-hour workshift.

- * **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS in humans. There may be no safe level of exposure to carcinogens, so all contact should be reduced to the lowest possible level.
- * The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

WAYS OF REDUCING EXPOSURE

- * Enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
- * A regulated, marked area should be established where **Polychlorinated Biphenyls** are handled, used, or stored.
- * Wear protective work clothing.
- * Wash thoroughly immediately after exposure to **Polychlorinated Biphenyls** and at the end of the workshift.
- * Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of **Polychlorinated Biphenyls** to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Polychlorinated Biphenyls**:

- * **Polychlorinated Biphenyls** can irritate and burn the eyes.
- * Exposure to the vapor can irritate the nose and throat causing cough and/or difficulty in breathing.
- * **Polychlorinated Biphenyls** can cause nausea, vomiting, loss of weight and stomach pain.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Polychlorinated Biphenyls** and can last for months or years:

Cancer Hazard

- * **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS in humans. There is some evidence that they cause skin cancer in humans and they have been shown to cause liver cancer in animals.
- * Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- * **Polychlorinated Biphenyls** can affect the reproductive system of adults.

Other Long-Term Effects

- * **Polychlorinated Biphenyls** may cause an acne-like rash (chloracne) following skin contact, which may persist for years.
- * High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles") in the arms and legs.
- * **Polychlorinated Biphenyls** may cause liver damage.

MEDICAL

Medical Testing

Before beginning employment and at regular times after that, the following are recommended:

- * Liver function tests.
- * Exam of the skin.

If symptoms develop or overexposure is suspected, the following are recommended:

- * Blood **PCB** levels.
- * Exam of the nervous system.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.1020.

Mixed Exposures

- * Because more than light alcohol consumption can cause liver damage, drinking alcohol can increase the liver damage caused by **Polychlorinated Biphenyls**.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, **ENGINEERING CONTROLS** are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following control is recommended:

- * Where possible, automatically transfer **Polychlorinated Biphenyls** or pump liquid **Polychlorinated Biphenyls** from drums or other storage containers to process containers.

Good **WORK PRACTICES** can help to reduce hazardous exposures. The following work practices are recommended:

- * Workers whose clothing has been contaminated by **Polychlorinated Biphenyls** should change into clean clothing promptly.
- * Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to **Polychlorinated Biphenyls**.
- * Eye wash fountains should be provided in the immediate work area for emergency use.

- * If there is the possibility of skin exposure, emergency shower facilities should be provided.
- * On skin contact with **Polychlorinated Biphenyls**, immediately wash or shower to remove the chemical. At the end of the workshift, wash any areas of the body that may have contacted **Polychlorinated Biphenyls**, whether or not known skin contact has occurred.
- * Do not eat, smoke, or drink where **Polychlorinated Biphenyls** are handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating, drinking, applying cosmetics, smoking, or using the toilet.
- * If a crystalline solid, when vacuuming, a high efficiency particulate absolute (HEPA) filter should be used, not a standard shop vacuum.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

OSHA 1910.132 requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

- * Avoid skin contact with **Polychlorinated Biphenyls**. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
- * All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- * For solid **Polychlorinated Biphenyls** wear eye protection with side shields or goggles.
- * Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- * Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

- * Where the potential exists for exposure over **0.001 mg/m³**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.

HANDLING AND STORAGE

- * Prior to working with **Polychlorinated Biphenyls** you should be trained on its proper handling and storage.
- * A regulated, marked area should be established where **Polychlorinated Biphenyls** are handled, used, or stored.
- * **Polychlorinated Biphenyls** are not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).
- * Store in tightly closed containers in a cool, well-ventilated area.

QUESTIONS AND ANSWERS

- Q: If I have acute health effects, will I later get chronic health effects?
- A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.
- Q: Can I get long-term effects without ever having short-term effects?
- A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.
- Q: What are my chances of getting sick when I have been exposed to chemicals?
- A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.
- Q: When are higher exposures more likely?
- A: Conditions which increase risk of exposure include dust releasing operations (grinding, mixing, blasting, dumping, etc.), other physical and mechanical processes (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and "confined space" exposures (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?

A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. This may be a problem for children or people who are already ill.

Q: Don't all chemicals cause cancer?

A: No. Most chemicals tested by scientists are not cancer-causing.

Q: Should I be concerned if a chemical causes cancer in animals?

A: Yes. Most scientists agree that a chemical that causes cancer in animals should be treated as a suspected human carcinogen unless proven otherwise.

Q: But don't they test animals using much higher levels of a chemical than people usually are exposed to?

A: Yes. That's so effects can be seen more clearly using fewer animals. But high doses alone don't cause cancer unless it's a cancer agent. In fact, a chemical that causes cancer in animals at high doses could cause cancer in humans exposed to low doses.

Q: Can men as well as women be affected by chemicals that cause reproductive system damage?

A: Yes. Some chemicals reduce potency or fertility in both men and women. Some damage sperm and eggs, possibly leading to birth defects.

Q: Who is at the greatest risk from reproductive hazards?

A: Pregnant women are at greatest risk from chemicals that harm the developing fetus. However, chemicals may affect the ability to have children, so both men and women of childbearing age are at high risk.

The following information is available from:

New Jersey Department of Health and Senior Services
Occupational Health Service
PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863
(609) 984-7407 (fax)

Web address: <http://www.state.nj.us/health/eoh/odisweb/>

Industrial Hygiene Information

Industrial hygienists are available to answer your questions regarding the control of chemical exposures using exhaust ventilation, special work practices, good housekeeping, good hygiene practices, and personal protective equipment including respirators. In addition, they can help to interpret the results of industrial hygiene survey data.

Medical Evaluation

If you think you are becoming sick because of exposure to chemicals at your workplace, you may call personnel at the Department of Health and Senior Services, Occupational Health Service, who can help you find the information you need.

Public Presentations

Presentations and educational programs on occupational health or the Right to Know Act can be organized for labor unions, trade associations and other groups.

Right to Know Information Resources

The Right to Know Infoline (609) 984-2202 can answer questions about the identity and potential health effects of chemicals, list of educational materials in occupational health, references used to prepare the Fact Sheets, preparation of the Right to Know Survey, education and training programs, labeling requirements, and general information regarding the Right to Know Act. Violations of the law should be reported to (609) 984-2202.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is assigned by the Chemical Abstracts Service to identify a specific chemical.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

HHAG is the Human Health Assessment Group of the federal EPA.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

A **miscible** substance is a liquid or gas that will evenly dissolve in another.

mg/m³ means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NAERG is the North American Emergency Response Guidebook. It was jointly developed by Transport Canada, the United States Department of Transportation and the Secretariat of Communications and Transportation of Mexico. It is a guide for first responders to quickly identify the specific or generic hazards of material involved in a transportation incident, and to protect themselves and the general public during the initial response phase of the incident.

NCI is the National Cancer Institute, a federal agency that determines the cancer-causing potential of chemicals.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEL is the Permissible Exposure Limit which is enforceable by the Occupational Safety and Health Administration.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

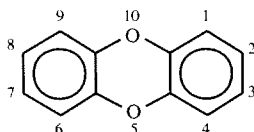
A **teratogen** is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

3. CHEMICAL AND PHYSICAL INFORMATION

CDDs are a class of related chlorinated hydrocarbons which are structurally similar. The basic structure is a dibenzo-*p*-dioxin (DD) molecule, which is comprised of 2 benzene rings joined at their *para* carbons by 2 oxygen atoms. There are 8 homologues of CDDs, monochlorinated through octachlorinated. The class of CDDs contains 75 congeners, consisting of 2 monochlorodibenzo-*p*-dioxins (MCDDs), 10 dichlorodibenzo-*p*-dioxins (DCDDs), 14 trichlorodibenzo-*p*-dioxins (TrCDDs), 22 tetrachlorodibenzo-*p*-dioxins (TCDDs), 14 pentachlorodibenzo-*p*-dioxins (PeCDD), 10 hexachlorodibenzo-*p*-dioxins (HxCDDs), 2 heptachlorodibenzo-*p*-dioxins (HpCDDs), and a single octachlorodibenzo-*p*-dioxin (OCDD) (Ryan et al. 1991). The general structure of the dibenzo-*p*-dioxins is shown below. The numbers indicate the positions for chlorine substitutions, excluding, of course, positions 5 and 10.



Not all congeners have been studied for their chemical and physical properties, but basic properties are known for the CDDs as a chemical family and for the homologous groups. Chlorinated dioxins exist as colorless solids or crystals in the pure state. They have a low solubility in water and a low volatility. Chlorinated dioxins have an affinity for particulates and readily partition to particles in air, water, and soil. The more toxic compounds appear to be the 2,3,7,8-substituted tetra-, penta-, and hexachloro compounds (i.e., 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 1,2,3,4,7,8-HxCDD, 1,2,3,6,7,8-HxCDD, and 1,2,3,7,8,9-HxCDD). These are also the congeners, along with OCDD, that have the greatest tendency to bioaccumulate. One of the most toxic congeners in mammals is believed to be 2,3,7,8-TCDD; this compound has also been the most studied of the TCDD congeners.

3.1 CHEMICAL IDENTITY

Information regarding the chemical identities of CDDs is presented in Table 3-1.

3.2 PHYSICAL AND CHEMICAL PROPERTIES

Information regarding the physical and chemical properties of CDDs is presented in Table 3-2.

Table 3-1. Chemical Identity of CDDs^a

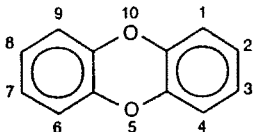
Characteristic	Monochlorodibenzo-p-dioxins	Dichlorodibenzo-p-dioxins
Chemical Name	1-Chlorodibenzo-p-dioxin (CAS #39227-53-7); 2-Chlorodibenzo-p-dioxin (CAS #39227-54-8) ^b	2,7-Dichlorobenzo-p-dioxin(CAS #33857-26-0) ^a
Synonym(s) ^j	1-Chlorodibenzo-p-dioxin; 1-Chlorodibenzo-p-dioxin; 1-Chlorodibenzo[b,e](1,4)dioxin ^c ; 2-Chlorodi- benzo(b,e)(1,4)dioxin ^b	1,3- or 1,6- or 2,3- or 2,7- or 2,8-Dichlorodibenzo-p- dioxin; 1,3- or 1,6- or 2,3- or 2,7- or 2,8-Dichlorodiben- zo[b,e](1,4)dioxin; 1,3- or 1,6- or 2,3- or 2,7- or 2,8- Dichlorodibenzodioxin ^b
Total number of possible isomers	2	10
Registered trade name(s)	No data	No data
Chemical formula	C ₁₂ H ₇ ClO ₂ ^c	C ₁₂ H ₆ Cl ₂ O ₂ ^b
Chemical structure ^{b,i}		See footnote "f"
Identification numbers: ^h CAS registry	39227-53-7 (1-) ^c 39227-54-8 (2-) ^b	50585-39-2 (1,3-); 38178-38-0 (1,6-); 29446-15-9 (2,3-) ^c ; 33857-26-0 (2,7-) ^a ; 38964-22-6 (2,8-) ^c
NIOSH RTECS	HP3095300 (1-); HP3095500 (2-) ^c	HP3095700 (1,3-); HP3095800 (1,6-); HP3096000 (2,3-) ^c ; HP3100000 (2,7-) ^a ; HP3150000 (2,8-) ^c
EPA hazardous waste	No data	No data
OHM/TADS	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data
HSDB	No data	4124 (2,7-) ^a
NCI	No data	CO3667 (2,7-) ^a

Table 3-1. Chemical Identity of CDDs^a (continued)

Characteristic	Trichlorodibenzo- <i>p</i> -dioxins	Tetrachlorodibenzo- <i>p</i> -dioxins ^g
Chemical name	1,2,4-Trichlorodibenzo- <i>p</i> -dioxin (CAS # 39227-58-2); 2,3,7-Trichlorodibenzo- <i>p</i> -dioxin (CAS # 33857-28-2) ^b	2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin (CAS # 1746-01-6) ^e
Synonym(s) ^j	1,2,4- or 2,3,7-Trichlorodibenzo- <i>para</i> -dioxin; 1,2,4- or 2,3,7-Trichlorodibenzo[<i>b,e</i>](1,4)dioxin; 1,2,4- or 2,3,7-Trichlorodibenzodioxin ^b	1,2,3,4- or 1,2,3,8- or 1,3,6,8- or 1,3,7,8- or 1,2,7,8- or 2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin ^d ; 1,2,3,4- or 1,2,3,8- or 1,2,7,8- or 1,3,6,8- or 1,3,7,8- or 2,3,7,8-Tetrachlorodibenzodioxin; 1,2,3,4- or 1,2,3,8- or 1,3,6,8- or 1,3,7,8- or 1,2,7,8- or 2,3,7,8-Tetrachlorodibenzo[<i>b,e</i>](1,4)dioxin; 1,2,7,8- or 2,3,7,8-Tetrachlorodibenzo-1,4-dioxin; 2,3,6,7-Tetrachloro-dibenzodioxin; 1,2,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin; Dioxin; TCDBD; TCDD ^b
Total number of possible isomers	14	22
Registered trade name(s)	No data	No data
Chemical formula	C ₁₂ H ₅ Cl ₃ O ₂ ^{e,i}	C ₁₂ H ₄ Cl ₄ O ₂ ^b
Chemical structure ^{b,i}	See footnote "f"	See footnote "f"
Identification numbers: ^h CAS registry	39227-58-2 (1,2,4-); 33857-28-2 (2,3,7-) ^c	30746-58-8 (1,2,3,4-); 53555-02-5 (1,2,3,8-); 34816-53-0 (1,2,7,8-); 33423-92-6 (1,3,6,8-); 50585-46-1 (1,3,7,8-) ^c 1746-01-6 (2,3,7,8-)^e
NIOSH RTECS	HP3530000 (1,2,4-); HP3630000 (2,3,7-) ^c	HP3493000 (1,2,3,4-); HP3494000 (1,2,3,8-); HP3494500 (1,2,7,8-); HP3495000 (1,3,6,8-); HP3495500 (1,3,7,8-) ^c ; HP3500000 (2,3,7,8-)^e
EPA hazardous waste	No data	No data
OHM/TADS	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data
HSDB	No data	4151 (2,3,7,8-) ^e
NCI	No data	C03714 (2,3,7,8-) ^e

Table 3-1. Chemical Identity of CDDs^a (continued)

Characteristics	Pentachlorodibenzo-p-dioxins	Hexachlorodibenzo-p-dioxins
Chemical name	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (CAS #40321-76-4) ^c	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (CAS #57653-85-7); 1,2,3,7,8,9- Hexachlorodibenzo-p-dioxin (CAS #19408-74-3); Hexachlorodibenzo-p-dioxin (CAS #34465-46-8) ^e
Synonym(s) ^l	1,2,3,4,7- or 1,2,3,7,8- or 1,2,4,7,8-Pentachlorodibenzo-para-dioxin; 1,2,3,4,7- or 1,2,3,7,8- or 1,2,4,7,8-Pentachlorodibenzodioxin; 1,2,3,4,7- or 1,2,3,7,8- or 1,2,4,7,8-Pentachlorodibenzo[b,e] (1,4)dioxin ^b	1,2,3,4,7,8- or 1,2,3,6,7,8- or 1,2,3,6,7,9- or 1,2,3,7,8,9- or 1,2,4,6,7,9-Hexachlorodi-benzo-para-dioxin; 1,2,3,4,7,8- or 1,2,3,6,7,8- or 1,2,3,6,7,9- or 1,2,3,7,8,9- or 1,2,4,6,7,9-Hexachlorodibenzodioxin ^b ; Hexachlorodibenzo(b,e) (1,4)dioxin ⁱ ; Hexachlorodibenzo-4-dioxin ^e
Total number of possible isomers	14	10
Registered trade name(s)	No data	No data
Chemical formula	C ₁₂ H ₃ Cl ₅ O ₂ ^c	C ₁₂ H ₂ Cl ₆ O ₂ ^b
Chemical structure ^{b,i}	See footnote "f"	See footnote "f"
Identification numbers: ^h CAS registry	39227-61-7 (1,2,3,4,7-); 40321-76-4 (1,2,3,7,8-); 58802-08-7 (1,2,4,7,8-) ^c	57653-85-7 (1,2,3,6,7,8-) ^a ; 64461-98-9 (1,2,3,6,7,9-) ^c ; 19408-74-3 (1,2,3,7,8,9-) ^a ; 39227-62-8 (1,2,4,6,7,9-) ^a ; 34465-46-8 ^e
NIOSH RTECS	HP3370000 (1,2,3,4,7-); HP3395000 (1,2,3,7,8-); HP3420000 (1,2,4,7,8-) ^c	HP3280000 (1,2,3,4,7,8-); HP3280100 (1,2,3,6,7,8-); HP3290000 (1,2,3,6,7,9-); HP3310000 (1,2,3,7,8,9-); HP3313000 (1,2,4,6,7,9-) ^c
EPA hazardous waste	No data	No data
OHM/TADS	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data
HSDB	No data	4154 (1,2,3,6,7,8-) ^a ; 6867 ^a ; 6866 (1,2,3,7,8,9-) ^a
NCI	No data	CO3703 (1,2,3,6,7,8-) ^a

Table 3-1. Chemical Identity of CDDs^a (continued)

Characteristic	Heptachlorodibenzo-p-dioxins	Octachlorodibenzo-p-dioxin
Chemical name	Heptachlorodibenzo-p-dioxin (CAS #37871-00-4) ^a	Octachlorodibenzo-p-dioxin ^a
Synonym(s)	1,2,3,4,6,7,8- or 1,2,3,4,6,7,9-Heptachlorodibenzo-p-dioxin; 1,2,3,4,6,7,8- or 1,2,3,4,6,7,9-Heptachlorodibenzo[b,e](1,4) dioxin; 1,2,3,4,6,7,8- or 1,2,3,4,6,7,9-Heptachlorodibenzo-dioxin; 1,2,3,4,6,7,8- or 1,2,3,4,6,7,9-Heptachlorodibenzo-para-dioxin ^c ; Heptachlorodibenzo(b,e)(1,4)dioxin ^a	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin; OCDD; Octachlorodibenzodioxin; Octachlorodibenzo[b,e](1,4)dioxin; Octachlorodibenzo-p-dioxin; 1,2,3,4,6,7,8,9-Octachlorodibenzodioxin; 1,2,3,4,6,7,8,9-Octachlorodibenzo(b,e)(1,4)dioxin; Octachloro-para-dibenzodioxin ^b
Total number of possible isomers	2	1
Registered trade name(s)	No data	No data
Chemical formula	C ₁₂ HCl ₇ O ₂ ^c	C ₁₂ Cl ₈ O ₂ ^a
Chemical structure ^{b,f}	See footnote "f"	See footnote "f"
Identification numbers: ^h		
CAS registry	35822-46-9 (1,2,3,4,6,7,8-) ⁱ ; 58200-70-7 (1,2,3,4,6,7,9-) ^c ; 37871-00-4 (b,e)(1,4) ^a	3268-87-9 ^a
NIOSH RTECS	HP3190000 (1,2,3,4,6,7,8-) ^c ;	HP3350000 ^a
EPA hazardous waste	No data	No data
OHM/TADS	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data
HSDB	6474 (1,2,3,4,6,7,9-)(b,e)(1,4) ^a	6480 ^a
NCI	No data	CO3678 ^a

^a In some cases, information regarding chemical identity was not available for all isomers of a homologous class.

^b IARC 1977

^c RTECS 1996

^d 1,2,7,8- is the same isomer as 2,3,6,7-in tetrachlorodibenzo-p-dioxins

^e HSDB 1995

^f The structural formula of unsubstituted dibenzo-para-dioxin and the numbering of the carbon atoms in the ring are given under monochlorodibenzo-p-dioxins. The chlorinated dibenzo-para-dioxins contain chlorine atoms at the positions indicated in their names (IARC 1977).

^g Chemical identity information for 2,3,7,8-TCDD is shown in bold.

^h Specific chlorine substitutions are given in parentheses following the identification numbers when multiple identification numbers are given

ⁱ Aster 1995

^j Example, alternative nomenclature shown; not all possible isomers are listed but can be extrapolated from the general structure or from the literature (Ryan et al. 1991)

CAS = Chemical Abstracts Services; CDDs = chlorinated dibenzo-p-dioxins; DOT/UN/NA/IMCO = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

Table 3-2. Physical and Chemical Properties of CDDs^a

Characteristic	Monochlorodibenzo-p-dioxins	Dichlorodibenzo-p-dioxins	Trichlorodibenzo-p-dioxins
Molecular weight	218.6	253.1	287.5
Color	Colorless ^b	Colorless ^{b,k}	Colorless (1,2,4-) ^b
Physical state	Crystals (1-); solid (2-) ^b	Needles (1,6-); solid (2,3-, 2,8-); crystals (2,7-) ^b	Solid (1,2,4-) ^b
Melting point	105.5 °C (1-); 89.0 °C (2-) ^d	114-115 °C (1,3-); 184-185 °C (1,6-) ^b ; 164 °C (2,3-); 210 °C (2,7); 151 °C (2,8-) ^d	129 °C (1,2,4-) ^d ; 128-129 °C (1,2,4-) ^b ; 153-163 °C (2,3,7-) ^b
Boiling point	No data	No data	374 °C ^l
Density: at 25 °C	No data	No data	No data
Odor	No data	No data	No data
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Solubility:			
Water at 25 °C ^h	0.417 mg/L (1-); 0.278-0.318 mg/L (2-) ^d	0.0149 mg/L (2,3-); 0.00375 mg/L (2,7-); 0.0167 mg/L (2,8-) ^d	0.00841 mg/L (1,2,4-) ^d ; 4.75x10 ⁻³ mg/L ^l
Organic solvent(s) ^p	No data	No data	No data
Partition coefficients:			
Log K _{ow}	4.52-5.45 (1-,2-) ^f	5.86-6.39 (2,7-) ^f	6.86-7.45 (1,2,4-) ^f
Log K _{oc}	No data	No data	No data

Table 3-2. Physical and Chemical Properties of CDDs^a (continued)

Characteristic	Monochlorodibenzo-p-dioxins	Dichlorodibenzo-p-dioxins	Trichlorodibenzo-p-dioxins
Vapor pressure at 25 °C	9.0x10 ⁻⁵ mm Hg (1-); 1.3x10 ⁻⁴ mm Hg (2-) ^e	2.9x10 ⁻⁶ mm Hg (2,3-); 9.0x10 ⁻⁷ mm Hg (2,7-); 1.1x10 ⁻⁶ mm Hg (2,8-) ^e	2.7x10 ⁻⁷ mm Hg (1,3,7-); 7.5x10 ⁻⁷ mm Hg (1,2,4-) ^e ; 6.46 x 10 ⁻⁸ mm Hg ^f
Henry's law constant at 25 °C	82.7x10 ⁻⁶ to 146.26x10 ⁻⁶ atm·m ³ /mol ^d	21.02x10 ⁻⁶ to 80.04x10 ⁻⁶ atm·m ³ /mol (2,3-, 2,7-, 2,8-) ^d	37.9x10 ⁻⁶ atm·m ³ /mol (1,2,4-) ^d
Degradation	atmospheric lifetime using gas- phase reaction with OH radical = 0.5 days ^g	atmospheric lifetime using gas- phase reaction with OH radical = 0.5 to 0.7 days ^g	atmospheric lifetime using gas- phase reaction with OH radical = 0.7 to 0.9 days ^g
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	No data
Flammability limits	No data	No data	No data
Conversion factors in air at 25 °C, 760 mm Hg	1 mg/m ³ = 0.112 ppm; 1 ppm = 8.94 mg/m ³	1 mg/m ³ = 0.0966 ppm; 1 ppm = 10.35 mg/m ³	1 mg/m ³ = 0.0850 ppm; 1 ppm = 11.76 mg/m ³
Explosive limits	No data	No data	No data

Table 3-2. Physical and Chemical Properties of CDDs^a (continued)

Characteristic	Tetrachlorodibenzo-p-dioxins ⁿ	Pentachlorodibenzo-p-dioxins	Hexachlorodibenzo-p-dioxins
Molecular weight	322	356.4	390.9
Color	White or colorless ^{b,c} (2,3,7,8-); colorless needles (2,3,7,8-) ^k ; colorless (1,2,3,4-, 1,3,6,8-) ^b	Colorless (1,2,3,4,7-) ^b	Colorless (1,2,3,4,7,8-, 1,2,4,6,7,9-) ^b
Physical state	Crystalline solid ^c (2,3,7,8-)	Solid (1,2,3,4,7-) ^b	Solid (1,2,3,4,7,8-, 1,2,4,6,7,9-) ^b
Melting point	190 °C (1,2,3,4-); 175 °C (1,2,3,7-) ^d ; 219-219.5 °C (1,3,6,8-); 193.5-195 °C (1,3,7,8-); 305-306 °C (2,3,7,8-) ^b	195-196 °C (1,2,3,4,7-); 240-241 °C (1,2,3,7,8-); 205-206 °C (1,2,4,7,8-) ^b	273 °C (1,2,3,4,7,8-) ^d ; 275 °C (1,2,3,4,7,8-) ^b ; 285-286 °C (1,2,3,6,7,8-); 243-244 °C (1,2,3,7,8,9-); 238-240 °C (1,2,4,6,7,9-) ^b
Boiling point	446.5 °C ^f (2,3,7,8-)	No data	No data
Density: at 25 °C	1.827 g/mL ^g (2,3,7,8-)	No data	No data
Odor	No data	No data	No data
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Solubility:			
Water at 25 °C	4.7x10 ⁻⁴ -6.3x10 ⁻⁴ mg/L (1,2,3,4-) ^{d,i} 4.2x10 ⁻⁴ mg/L (20 °C) (1,2,3,7-); 3.2x10 ⁻⁴ mg/L (20 °C) (1,3,6,8-); 1.9x10 ⁻⁵ mg/L (2,3,7,8) ^f 7.9x10 ⁻⁶ -3.2x10 ⁻⁴ mg/L (2,3,7,8-) ^d	1.18x10 ⁻⁴ mg/L (20 °C) (1,2,3,4,7-) ^d	4.42x10 ⁻⁶ mg/L (20 °C) (1,2,3,4,7,8-) ^d
Organic solvent(s) ^p	<u>o</u> -dichlorobenzene, chloro- benzene, benzene, chloroform, n- octanol ^b	No data	No data
Partition coefficients:			
Log K _{ow}	7.02-8.7 (1,2,3,7-) ^{l,a} ; 7.02 (2,3,7,8-) ^d ; 7.39-7.58 (2,3,7,8-) ^j ; 6.8 (2,3,7,8-TCDD) ^m ; 6.6 (1,2,3,4- TCDD) ^m	8.64-9.48 (1,2,3,4,7-) ^d	9.19-10.4 (1,2,3,4,7,8-) ^l
Log K _{oc}	No data	No data	No data

Table 3-2. Physical and Chemical Properties of CDDs^a (continued)

Characteristic	Tetrachlorodibenzo-p-dioxins ⁿ	Pentachlorodibenzo-p-dioxins	Hexachlorodibenzo-p-dioxins
Vapor pressure at 25 °C	7.5x10 ⁻⁹ mm Hg (1,2,3,7-) ^d ; 4.8x10 ⁻⁸ mm Hg (1,2,3,4-) ^e ; 1.5x10 ⁻⁹ -3.4x10 ⁻⁵ mm Hg (2,3,7,8-) ^e ; 5.3x10 ⁻⁹ -4.0x10 ⁻³ mm Hg (1,3,6,8-) ^d ; 7.4x10 ⁻¹⁰ mm Hg (2,3,7,8-) ^k	6.6x10 ⁻¹⁰ mm Hg (1,2,3,4,7-) ^d	3.8x10 ⁻¹¹ mm Hg (1,2,3,4,7,8-) ^d
Henry's law constant at 25 °C	16.1x10 ⁻⁶ –101.7x10 ⁻⁶ atm·m ³ /mol (2,3,7,8-); 7.01x10 ⁻⁶ –101.7x10 ⁻⁶ atm·m ³ /mol ^d	2.6x10 ⁻⁶ atm·m ³ /mol (1,2,3,4,7-) ^d	44.6x10 ⁻⁶ atm·m ³ /mol (1,2,3,4,7,8-) ^d
Degradation	photodegradation half-life on grass (2,3,7,8-)=44 h(k ₂ = 0.0156 h ⁻¹) ^{m,o} ; atmospheric lifetime using gas-phase reaction with OH radical = 0.8 to 2 days ^q	atmospheric lifetime using gas- phase reaction with OH radical = 1.1 to 2.4 days ^q	atmospheric lifetime using gas- phase reaction with OH radical = 1.5 to 3.4 days ^q
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	No data
Flammability limits	No data	No data	No data
Conversion factors in air at 25 °C, 760 mm Hg	1 mg/m ³ = 0.0759 ppm 1 ppm = 13.17 mg/m ³	1 mg/m ³ = 0.0686 ppm 1 ppm = 14.58 mg/m ³	1 mg/m ³ = 0.0625 ppm 1 ppm = 15.99 mg/m ³
Explosive limits	No data	No data	No data

Table 3-2. Physical and Chemical Properties of CDDs^a (continued)

Characteristic	Heptachlorodibenzo-p-dioxins	Octachlorodibenzo-p-dioxin
Molecular weight	425.3	459.8
Color	No data	No data
Physical state	No data	No data
Melting point	265 °C (1,2,3,4,6,7,8-) ^d	332 °C ^d ; 330 °C ^k
Boiling point	507.2 °C ^e	510 °C ^e ; 485 °C ^m
Density: at 25 °C	No data	No data
Odor	No data	No data
Odor threshold:		
Water	No data	No data
Air	No data	No data
Solubility:		
Water at 25 °C	2.4x10 ⁻⁶ mg/L at 20°C (1,2,3,4,6,7,8-) ^d ; 1.9x10 ⁻³ mg/L at 20°C (b,e)(1,4) ^k	7.4x10 ⁻⁸ mg/L ^d ; 0.4±0.1x10 ⁻⁹ g/L at 20 °C ^k ; 2.27x10 ⁻⁹ mg/L ^m
Organic solvent(s) ^p	No data	Acetic acid, anisole, chloroform, o-dichlorobenzene, dioxane, diphenyl oxide, pyridine, xylene ^b
Partition coefficients:		
Log K _{ow}	9.69–11.38 (1,2,3,4,6,7,8-) ⁱ	10.07–12.26 ⁱ ; 8.78–13.37 ^k
Log K _{oc}	No data	No data
Vapor pressure at 25 °C	5.6x10 ⁻¹² mm Hg; (1,2,3,4,6,7,8-) ^a ; 7.4x10 ⁻⁸ mm Hg (b,e)(1,4) ^k	8.25x10 ⁻¹³ mm Hg ^e ; 1.68x10 ⁻¹² m ^m
Henry's law constant at 25 °C	1.31x10 ⁻⁶ atm·m ³ /mol (1,2,3,4,6,7,8-) ^d ; 2.18x10 ⁻⁵ atm·m ³ /mol ^k	6.74x10 ⁻⁶ atm·m ³ /mol ^{d,k}

Table 3-2. Physical and Chemical Properties of CDDs^a (continued)

Characteristic	Heptachlorodibenzo-p-dioxins	Octachlorodibenzo-p-dioxin
Degradation	Atmospheric lifetime using gas-phase reaction with OH radical = 4.4 days ^a	Atmospheric lifetime using gas-phase reaction with OH radical = 9.6 days ^a
Autoignition temperature	No data	No data
Flashpoint	No data	No data
Flammability limits	No data	No data
Conversion factors in air at 25 °C, 760 mm Hg	1 mg/m ³ = 0.0575 ppm 1 ppm = 17.39 mg/m ³	1 mg/m ³ = 0.0532 ppm 1 ppm = 18.81 mg/m ³
Explosive limits	No data	No data

^a In some cases, information regarding chemical and physical properties was not available for all isomers of a homologous class

^b IARC 1977

^c Sax and Lewis 1987

^d Shiu et al. 1988

^e Rordorf 1989

^f Webster et al. 1985

^g Schroy et al. 1985

^h Solubility is given for 25 °C unless noted otherwise in text.

ⁱ Doucette and Andren 1988

^j Des Rosiers 1986

^k HSDB 1995

^l ASTER 1995

^m McCrady and Maggard 1993

ⁿ Physical & chemical properties of 2,3,7,8-TCDD are shown in bold

^o k_2 = elimination rate constants

^p In most cases no specific solubilities were found. However, solvation in organic solvents such as toluene, hexane and methylene chloride is possible given that these solvents are used in extraction and analysis methods (see Chapter 6).

^q Atkinson 1991

^r Marple et al. 1986b

2. HEALTH EFFECTS

2.2. ANIMAL STUDIES

This section contains descriptions and evaluations of studies and presents levels of significant exposure for CDDs based on toxicological studies.

The information in this section is organized first by route of exposure—inhalation, oral, and dermal—and then by health effect—death, systemic, immunological, neurological, developmental, reproductive, genotoxic, and carcinogenic effects. These data are discussed in terms of three exposure periods—acute (14 days or less), intermediate (15–364 days), and chronic (365 days or more).

Levels of significant exposure for each route and duration are presented in tables and illustrated in figures. The points in the figures showing no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) reflect the actual doses (levels of exposure) used in the studies. LOAELs have been classified into "less serious" or "serious" effects. These distinctions are intended to help the users of the document identify the levels of exposure at which adverse health effects start to appear. They should also help to determine whether or not the effects vary with dose and/or duration, and place into perspective the possible significance of these effects to human health.

The significance of the exposure levels shown in the tables and figures may differ depending on the user's perspective. For example, physicians concerned with the interpretation of clinical findings in exposed persons may be interested in levels of exposure associated with "serious" effects. Public health officials and project managers concerned with appropriate actions to take at hazardous waste sites may want information on levels of exposure associated with more subtle effects in humans or animals (LOAEL) or exposure levels below which no adverse effects (NOAEL) have been observed. Estimates of levels posing minimal risk to humans (Minimal Risk Levels, MRLs) may be of interest to health professionals and citizens alike.

Levels of exposure associated with carcinogenic effects (Cancer Effect Levels, CELs) of CDDs are indicated in Tables 2-2, 2-3, and 2-4 and Figures 2-1 and 2-2.

Estimates of exposure levels posing minimal risk to humans (MRLs) have been made (see Section 2.5), where data were believed reliable, for the most sensitive noncancer effect for each exposure duration. MRLs include adjustments to reflect human variability and extrapolation of data from laboratory animals to humans.

2. HEALTH EFFECTS

Although methods have been established to derive these levels (Barnes et al. 1988; EPA 1989c), uncertainties are associated with these techniques. Furthermore, ATSDR acknowledges additional uncertainties inherent in the application of the procedures to derive less than lifetime MRLs. As an example, acute inhalation MRLs may not be protective for health effects that are delayed in development or are acquired following repeated acute insults, such as hypersensitivity reactions, asthma, or chronic bronchitis. As these kinds of health effects data become available and methods to assess levels of significant human exposure improve, these MRLs will be revised.

2.2.1 Inhalation Exposure

No studies were located regarding the following health effects in animals after inhalation exposure to CDDs:

2.2.1.1 Death

2.2.1.2 Systemic Effects

2.2.1.3 Immunological Effects

2.2.1.4 Neurological Effects

2.2.1.5 Reproductive Effects

2.2.1.6 Developmental Effects

2.2.1.7 Genotoxic Effects

Genotoxicity studies are discussed in Section 2.5.

2.2.1.8 Cancer

No studies were located regarding cancer in animals after inhalation exposure to CDDs.

2.2.2 Oral Exposure

Information regarding adverse health effects in animals exposed to CDDs via the oral route was located for the following congeners: 2-monochlorodibenzo-*p*-dioxin (2-MCDD), 2,3-dichlorodibenzo-*p*-dioxin (2,3-DCDD), 2,7-dichlorodibenzo-*p*-dioxin (2,7-DCDD), 1,2,3-trichlorodibenzo-*p*-dioxin (1,2,3-TrCDD), 1,2,3,4-tetrachlorodibenzo-*p*-dioxin (1,2,3,4-TCDD), 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD), 1,2,3,7,8-pentachlorodibenzo-*p*-dioxin (1,2,3,7,8-PeCDD), 1,2,3,4,7,8-hexachlorodibenzo-*p*-dioxin (1,2,3,4,7,8-HxCDD), 1,2,4,7,8-pentachlorodibenzo-*p*-dioxin (1,2,4,7,8-PeCDD),

2. HEALTH EFFECTS

1,2,3,6,7,8-hexachlorodibenzo-*p*-dioxin (1,2,3,6,7,8-HxCDD), 1,2,3,7,8,9-hexachlorodibenzo-*p*-dioxin (1,2,3,7,8,9-HxCDD), 1,2,3,4,6,7,8,-heptachlorodibenzo-*p*-dioxin (1,2,3,4,6,7,8,-HpCDD), and 1,2,3,4,6,7,8,9-octachlorodibenzo-*p*-dioxin (OCDD). Some of the animal studies used a mixture of 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD. Of all the CDD congeners, 2,3,7,8-TCDD has been the one most extensively studied.

2.2.2.1 Death

Numerous studies provided doses associated with death following exposure to CDDs in animals. LD₅₀ (lethal dose, kill for 50% of dosed animals during a certain time interval) values for each congener varied not only among species, but also among different strains.

LD₅₀ values following a single oral dose of 2,3,7,8-TCDD were calculated as 22 µg/kg (males) and 45 µg/kg (females) in Sherman rats (Schwetz et al. 1973); and 164 µg/kg, 297 µg/kg, 303 µg/kg, and 340 µg/kg in Fischer 344 rats from Charles River Breeding Laboratories, Charles River CD, Frederick Cancer Research Center, and Harlan Industries, respectively (Walden and Schiller 1985); 165 µg/kg (males) and 125 µg/kg (females) in Osborne Mendel rats (NTP 1982b); 43 µg/kg in male Sprague-Dawley rats (Stahl et al. 1992), and 60 and 100 µg/kg in female and male Long Evans rats, respectively (Fan and Rozman 1995). A single gavage dose of 100 µg/kg caused death in 95% of exposed male Fischer 344 rats (Kelling et al. 1985), and a dose of 25 µg/kg led to the death of 25% of exposed male Sprague-Dawley rats (Seefeld et al. 1984a). Furthermore, the reported LD₅₀ values were 4.2 µg/kg in minks (Hochstein et al. 1988), 115 µg/kg in New Zealand albino rabbits (Schwetz et al. 1973b), 1.75 µg/kg in male Hartley guinea pigs (McConnell et al. 1984), 0.6 µg/kg (males) and 2.1 µg/kg (females) in Hartley guinea pigs (Schwetz et al. 1973b), and 1,157 µg/kg (Olson et al. 1980a) or 5,051 µg/kg (Henck et al. 1981) in Syrian hamsters. A 42-day LD₅₀ of 2.5 µg/kg was calculated for female Hartley guinea pigs when 2,3,7,8-TCDD was administered in corn oil and 19 µg/kg when administered in methyl cellulose (Silkworth et al. 1982). No effect on survival was observed after a single oral dose of 200 µg/kg in B6C3F₁ mice (NTP 1982b), but 69% of C57BL/6 mice died following exposure to 360 µg/kg (Kelling et al. 1985), and an LD₅₀ was calculated as 146 µg/kg 2,3,7,8-TCDD in male C57BL mice (Smith et al. 1981). An acute LD₅₀ in excess of 3,000 µg/kg was reported for male DBA/2J mice (Weber et al. 1995). Increased lethality was observed in Hartley guinea pigs exposed to 0.03 µg/kg/day 2,3,7,8-TCDD in the feed for 11 days (DeCaprio et al. 1986) and in pregnant rabbits following 10 daily doses of 1 µg/kg during gestation (Giavini et al. 1982). Beagle dogs survived a single dose of 300 µg/kg but not 3,000 µg/kg (Schwetz et al. 1973). In addition, 3 of 12 pregnant rhesus

2. HEALTH EFFECTS

monkeys died following a single dose of 1 µg/kg (McNulty 1984). It is evident from the above results that guinea pigs were the most sensitive species, while hamsters were the most resistant (up to 5,000 times greater lethal doses). In all studies cited above, the animals died following a latency period of several days (mean values varied from 9 to 43). In almost all laboratory animals, a pronounced wasting syndrome appears to be a major contributor to lethality.

In the intermediate-duration experiments, increased lethality was observed in Osborne Mendel rats exposed to 2,3,7,8-TCDD by gavage in oil vehicle at 0.56 µg/kg/day for up to 13 weeks (NTP 1982b). Mortality of 5% (no deaths in controls) was observed in Sprague-Dawley rats administered 2,3,7,8-TCDD by gavage at a rate of approximately 0.8 µg 2,3,7,8-TCDD/kg/day for 13 weeks (Viluksela et al. 1994); the first death occurred on day 57. Four of 7 male Sprague-Dawley rats dosed by gavage with approximately 1.6 µg 2,3,7,8-TCDD/kg/day died in a 10-week study (Li and Rozman 1995); the mean time to death was 53.5 days. Increased mortality was reported in Hartley guinea pigs exposed daily for up to 60 days to diets that provided 0.03 µg/kg/day (DeCaprio et al. 1986); 4 of 10 males died by day 42 and 4 of 10 females by day 59. In a dietary study, all male Sprague-Dawley rats that received the diet that provided the highest doses (3.4 µg/kg/day or more) died within 4 weeks (Van Miller et al. 1977). C57BL/6 mice had decreased survival following exposure by gavage to 3 µg/kg/day of 2,3,7,8-TCDD 3 days a week for 25 weeks (Umbreit et al. 1987). Two monkeys were exposed intermittently by gavage to 0.6 µg/kg/day of 2,3,7,8-TCDD for 3 weeks and both died (McNulty 1984); 5 of 8 monkeys died within 2 months following exposure to diets that provided 0.02 µg/kg/day (Hong et al. 1989); also, 5 of 8 monkeys died within 9 months of dietary exposure to 0.011 µg/kg/day (Allen et al. 1977). In all species, severe weight loss and body fat depletion were experienced prior to death, but usually no other overt toxic signs were observed. Pancytopenia, a secondary effect, was the cause of death in monkeys.

Decreased survival was reported after chronic exposure to CDDs. Chronic dietary exposure to 2,3,7,8-TCDD increased the mortality over controls in Sprague-Dawley rats at 0.1 µg/kg/day (Kociba et al. 1978a). Increased mortality also occurred in Swiss mice given 2,3,7,8-TCDD by gavage at 1.0 µg/kg/day (Toth et al. 1979) and in B6C3F₁ mice at 0.36 µg/kg/day (Della Porta et al. 1987). In both studies, the mice were dosed once a week for 1 year and followed for the rest of their lives or until 110 weeks of age. No treatment-related effects on survival were observed in Osborne-Mendel rats or in B6C3F₁ mice administered up to 0.25 µg 2,3,7,8-TCDD/kg/day, 2 days a week by gavage for 104 weeks (0.071 µg/kg/day for rats and male mice; 0.3 µg/kg/day for female mice) (NTP 1982b).

2. HEALTH EFFECTS

Increased mortality occurred after acute exposure to other congeners. After a single oral dose of a mixture of 1,2,3,7,8,9-HxCDD and 1,2,3,6,7,8-HxCDD, LD₅₀ values were calculated as 1,800 µg/kg and 800 µg/kg in male and female Osborne-Mendel rats, respectively, and 750 µg/kg and 500 µg/kg in male and female B6C3F₁ mice, respectively (NCI/NTP 1980). In addition, LD₅₀ values were calculated for several congeners in guinea pigs (29,444 µg/kg for 1,2,3-TrCDD, 1,125 µg/kg for 1,2,4,7,8-PeCDD, 3.1 µg/kg for 1,2,3,7,8-PCDD, 70–100 µg/kg for 1,2,3,6,7,8-HxCDD, 60–100 µg/kg for 1,2,3,7,8,9-HxCDD, and 72.5 µg/kg for 1,2,3,4,7,8-HxCDD) and in mice (825 µg/kg for 1,2,3,4,7,8-HxCDD and 337.5 µg/kg for 1,2,3,7,8-PCDD) following a single oral exposure by gavage in oil vehicle (McConnell et al. 1978b). In male Sprague-Dawley rats, the oral LD₅₀ for 1,2,3,7,8-PCDD, 1,2,3,4,7,8-HxCDD, and 1,2,3,4,6,7,8-HpCDD administered in corn oil/acetone (95/5) was 206, 887, and 6,325 µg/kg, respectively (Stahl et al. 1992). Other CDD congeners have a much lower order of toxicity, as evidenced by data showing no effects on mortality at much higher doses than those of 2,3,7,8-TCDD, TrCDD, HxCDD, or PCDD that cause death. No deaths were observed after a single oral dose of 1×10^6 and 2×10^6 µg/kg 2,7-DCDD in Sprague-Dawley rats and Swiss Webster mice, respectively (Schwetz et al. 1973). In addition, rats and mice survived acute oral doses of 1×10^6 and 4×10^6 µg/kg OCDD, respectively (Schwetz et al. 1973). The relative species differences in sensitivity for 2,3,7,8-TCDD also applied for other congeners.

Mortality rates of 15 and 50% were reported in groups of male Sprague-Dawley rats administered 73 and 110 µg 1,2,3,4,6,7,8-HpCDD/kg/day by gavage for 13 weeks, respectively (Viluksela et al. 1994). At the highest dose, the first death occurred on day 31; at the 73 µg/kg/day dose, on day 41. Fifteen out of 20 female Sprague-Dawley rats died during a 13-week treatment period with daily doses of approximately 2.6 µg 1,2,3,7,8-PeCDD/kg (total dose was 233 µg/kg) (Viluksela et al. 1998a). The first death occurred on day 16. The same mortality rate was observed in males treated with approximately 3.8 µg/kg/day (total dose was 350 µg/kg). In the same study, administration of approximately 10.3 µg 1,2,3,4,7,8-HxCDD resulted in a 25% death rate (5/20, first death on day 61) in female rats; the same death rate was seen among male rats treated with approximately 15.4 µg/kg/day (first death on day 24). The main causes of death were wasting syndrome, hemorrhage, and anemia (Viluksela et al. 1998a). No effects on survival were observed following chronic dietary exposure of Osborne-Mendel rats and B6C3F₁ mice to 5×10^5 µg/kg/day of 2,7-DCDD and to 1.3×10^6 µg/kg/day of 2,7-DCDD, respectively (NCI/NTP 1979a), or following chronic gavage dosing with a mixture of 1,2,3,7,8,9-HxCDD and 1,2,3,6,7,8-HxCDD at 0.34 µg/kg/day and 0.7 µg/kg/day, respectively (NCI/NTP 1980).

2. HEALTH EFFECTS

In conclusion, 2,3,7,8-TCDD was the most toxic of all congeners tested, and doses on the order of several $\mu\text{g/kg}$ body weight have led to death in all species tested, except hamsters and dogs, in acute-exposure experiments. In contrast, of the congeners tested, 2,7-DCDD and OCDD were the least toxic as tested animals survived very high doses (g/kg body weight). The wasting syndrome was the major toxic effect of acute- and intermediate-duration exposure to CDDs in most species. It was characterized by body weight loss, adipose tissue depletion, and eventual death. In most of the chronic duration studies the cause of death was not determined.

The LD_{50} values and all reliable representative LOAEL values for death in each species and duration category for each congener tested are recorded in Tables 2-2 and 2-3 and plotted in Figures 2-1 and 2-2.

2.2.2.2 Systemic Effects

The highest NOAEL values and all reliable representative LOAEL values for each systemic effect in each species and duration category for each congener tested are recorded in Tables 2-2 and 2-3 and plotted in Figures 2-1 and 2-2.

Respiratory Effects. Few studies have examined the respiratory system in animals following oral exposure to CDDs. However, serious respiratory effects have been observed in monkeys that died from 2,3,7,8-TCDD exposure.

Bleeding from the nose was reported in rhesus monkeys exposed via gavage to $0.1 \mu\text{g/kg/day}$, 3 days a week for 3 weeks (McNulty 1984). Hemorrhage, hyperplasia, and metaplasia of the bronchial epithelium (as well as at other organ sites that had mucous-secreting cells) developed in monkeys exposed to diets providing $0.011 \mu\text{g/kg/day}$ for 9 months (Allen et al. 1977); 5 of 8 monkeys died with this dose level. Focal alveolar hyperplasia and squamous metaplasia and carcinoma were reported in Sprague-Dawley rats chronically exposed to $0.1 \mu\text{g/kg/day}$ 2,3,7,8-TCDD in the feed (Kociba et al. 1978a). Since powdered feed containing 2,3,7,8-TCDD was given to the rats, there is a distinct possibility that the respiratory effects were attributable to inhalation exposure rather than oral systemic absorption. In contrast, no respiratory effects were observed in rats or mice chronically exposed by gavage to 2,3,7,8-TCDD at approximately $0.071 \mu\text{g/kg/day}$ or $0.3 \mu\text{g/kg/day}$, respectively (NTP 1982b).

APPENDIX D

EXCAVATION SAFETY PROGRAM

7.0 EXCAVATION AND TRENCHING

Studies show that excavation work is one of the most hazardous types of work conducted in the construction industry. Accidents occur more frequently in excavation work than in construction work in general. The primary type of accident related to excavation work is the cave-in. Cave-ins result in over 100 fatalities a year in North America. When compared to the total number of accidents in all of construction, the actual number of cave-ins is not large; however, they are very serious in nature and much more likely to be fatal than other types of construction accidents.

Excavation activities during CRA projects have the potential to create oxygen-deficient, explosive, and/or toxic atmospheres. Adequate precautions must be taken to prevent employees entering excavations from being exposed to a hazardous atmosphere.

Serious accidents and injury can occur to employees working in excavations and trenches due to cave-ins and hazardous atmospheres. Rescue attempts in any excavation or trench cave-in should be approached with the safety of the rescuers in mind.

A. POLICY

All CRA excavation and trenching operations for which employees shall enter or be exposed shall have a safety plan in place and shall be observed by a designated competent person. The competent person shall be responsible for evaluating and inspecting excavation and trenching operations to prevent possible cave-in and entrapment, and to avoid other hazards presented by excavation activities.

Each employee in an excavation shall be protected from cave-ins by one of three systems:

1. Sloping and benching systems.
2. Shoring.
3. Shielding systems.

There is only one situation where such protective systems are not required; the excavation is less than 4 feet deep, and a competent person has determined that there is no indication of a potential cave-in.

All employees working in and around excavations and trenches shall receive training regarding the safe use of shoring and shielding equipment.

Employees may not design and fabricate their own protective systems. Only manufactured systems and systems designed and certified by professional engineers shall be used.

The competent person shall be responsible for recognizing conditions that might result in employees being exposed to hazardous atmospheres, and for monitoring air quality in accordance with this policy.

Prior to initiating work in excavations, the competent person shall outline the emergency procedures to be utilized in the event of an emergency in the excavation. All employees working in or near the trench shall be knowledgeable of these procedures.

In the event of any life-threatening incident, the employee shall immediately contact 911 or Dispatch for emergency assistance.

B. REGULATORY BACKGROUND

The OSHA excavation standard (29 CFR 1926.650-652) sets forth the safety requirements for all excavation and trenching activities including construction, inspection, and entry into excavations or trenches. In addition, HAZWOPER and the OSHA General Industry Standard (29 CFR 1910) include the same requirements for excavation and trenching by referencing the construction standard.

C. SAFE WORK PRACTICES

Utility Clearances

Prior to the commencement of any project and/or site work that include intrusive activities, utility clearances must be conducted. Elevated superstructures (e.g., drill rigs, backhoes, scaffolding, ladders, cranes) shall remain a distance of 10 feet away from utility lines (<50 kV) and 20 feet away from power lines. Underground utilities, if present, shall be clearly marked and identified prior to commencement of work.

Personnel involved in intrusive work shall:

- Review and adhere to CRA's subsurface utility clearance protocol.
- Utilize the Property Access/Utility Clearance Data Sheet (QSF-019).
- Be able to determine the minimum distance from marked utilities which work can be conducted with the assistance of the locator line service.
- Contact utility companies prior to the start of excavation work to mark the location of all underground utilities. Utility companies may take up to 4 days to respond to a call, so planning is recommended.

All exposed utility lines in an excavation must be properly supported.

Access and Egress

Personnel access and egress from trench and/or excavations are as follows:

- A stairway, ladder, ramp, or other means of egress must be provided in trenches greater than 4 feet deep and for every 25 feet of lateral travel.
- All ladders shall extend 3 feet above the top of the excavation.
- Structural ramps to be used by employees for access and egress must be designed by a competent person, qualified in structural design, or by a licensed professional engineer.

Vehicular Traffic

The following safety measures are to be taken by personnel that have the potential to be exposed to vehicle traffic:

- Safety vests shall be worn made of reflectorized or high-visibility material meeting ANSI Class II or III as applicable to traffic speeds.
- Employees shall work using the "buddy system".
- Cones, etc. shall be used to demarcate a safe work zone around the monitoring wells.
- Appropriate signage shall be posted as necessary to inform roadway/parking lot users of any additional control measures necessary to protect the public and CRA employees.

Falling Loads

Personnel are not permitted to work under or near loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by falling materials.

Protection from Water Accumulation

Employees must not work in excavations containing accumulated water unless adequate precautions have been taken. These precautions include special support or shield systems to prevent cave-ins, water removal, and/or use of a harness and lifeline.

The use of water removal equipment in an excavation must be monitored by a competent person.

Excavation work that interrupts the natural drainage of surface water shall use diversion ditches, dikes, or other suitable means to prevent surface runoff from entering the excavation. The competent person must inspect the excavation before employees enter the excavation after heavy rains.

Shoring, Shielding, and Trench Boxes

The following are general safety precautions to observe when using shoring, shielding, or trench boxes:

- Manufactured protective systems shall only be used according to the manufacturer's specifications, recommendations, and limitations. Copies of these data shall be made available at the project site.
- Plans and material specifications for manufactured protective systems designed by a professional engineer shall be made available at the project site.
- No manufactured protective system shall be subjected to loads in excess of those for which it was designed.
- Members of protective systems shall be securely connected to prevent sliding, falling, kick-outs, and other predictable failure.
- Installation of protective systems shall be closely coordinated with the progress of excavating or trenching operations.
- Protective systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapse, or being struck by members of the system.

- Excavations and trenches shall be backfilled as soon as possible following removal of the protective system.
- Excavation of material deeper than 2 feet below the support system shall be permitted only if the system is designed to resist the forces for the full depth of the excavation.

In addition to the general considerations above, one special consideration regarding shoring systems is that their removal shall begin at, and progress from, the bottom of the excavation.

The following are special precautions to observe when using shielding systems and trench boxes:

- Shields shall be installed in a manner which restricts lateral or other hazardous movement in the sudden application of lateral loads.
- Employees shall be protected from cave-in when entering or leaving areas protected by shields. This is to include all faces of the excavation (i.e., side walls and end walls).
- Employees shall not ride in shields when they are being installed, repositioned or removed.
- No employee shall be positioned under an elevated load.

Benching and Sloping

Bench and slope configurations are based on soil properties. With detailed information on soil properties, special benching and slope plans may be developed by the competent person, or professional engineer, that exceed the following minimum slope requirements. No other employees are authorized to make decisions on benching or sloping systems. There are four types of soil classifications as per OSHA. General information on the four types of soil is provided below:

- **Stable rock** – Natural solid mineral matter whose sides remain vertical when excavated;
- **Type A soil** – Cohesive soils (clay, silty clay, sandy clay, clay loam, and sometimes silty clay loam and sandy clay loam) with a compressive strength greater than 1.5 tons per square foot (tsf);
- **Type B soil** – Cohesive soils (granular, cohesive soil or silts) with a compressive strength between 0.5 to 1.5 tsf; and

- **Type C soil** – Cohesive soil with compressive strength less than 0.5 tsf, granular soils (gravel, sand, etc.), submerged soil and soil with water seepage, and submerged unstable rock.

Minimum Slope Requirements

In the absence of detailed information on soil properties, or whenever the soils involved are granular or saturated with water, the following minimum requirements for bench and slope construction shall apply:

- All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1 1/2:1 (34 degrees measured from the horizontal).
- All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or shored to a height of at least 18 inches above the top of the vertical side.
- All excavations deeper than 20 feet shall be designed by a professional engineer with knowledge of soil mechanics and state and OSHA excavation requirements. Copies of this designed system must be maintained at the project site.

Atmosphere Monitoring and Testing

There are three parameters by which air quality is measured: 1) oxygen concentration, 2) flammability, and 3) the presence of hazardous substances.

Employees must not be exposed to atmospheres containing less than 19.5 percent oxygen, or having a lower flammable limit greater than 10 percent; and employees must not be exposed to hazardous levels of atmospheric contaminants.

Air Quality Monitoring

Whenever potentially hazardous atmospheres are suspected in excavations and trenches, the atmosphere shall be tested by a competent person. Detector tubes, gas monitors, and explosion meters are examples of monitoring equipment that may be used.

In the event that an unusual odor or liquid is suspected in excavations and trenches, the competent person shall stop work on the site and arrange for air quality assessment and mitigation if necessary.

Atmospheric testing and monitoring shall be performed in excavations in or adjacent to landfill areas, in areas where hazardous materials are/were stored, or in areas where the presence of hazardous materials is suspected.

Air Quality Controls

Air quality can be controlled with proper ventilation and respiratory protection. When such controls are used, atmospheric monitoring shall be conducted as often as needed, but not less than every 30 minutes, to ensure that the atmosphere remains safe. Employees required to work under such conditions shall receive special training related to hazardous materials and respiratory protection.

Emergency Rescue Equipment

Emergency rescue equipment, such as breathing apparatus, a safety harness with lifeline, and any other appropriate safety equipment, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work. Communication to outside rescue providers shall be readily available prior to employees entering trenches. Rescue for cave-in situations shall be limited to hand implements, such as shovels, hoes, etc.

D. COMPETENT PERSON RESPONSIBILITIES

The competent person shall ensure that all surface structures (buildings, retaining walls, sidewalks, etc.) are removed or supported, as necessary, to safeguard employees.

The competent person shall ensure the location of all subsurface structures (utilities, pipelines, underground tanks, etc.) which might reasonably be encountered during the course of the excavation.

The competent person shall ensure that safe access and egress from the excavation or trench are provided. An exit must be provided if the excavation is 4 feet deeper or greater. This exit must be within 25 feet of every worker.

The competent person shall ensure that all employees exposed to vehicular traffic wear warning vests or other suitably marked clothing.

The competent person shall ensure that all excavations and trenches are properly barricaded, flagged, or otherwise protected, and that a designated spotter is assigned to warn approaching machinery and pedestrians of the hazards.

The competent person shall prevent exposure of employees to hazardous atmospheres in excavations and trenches through the administration of an appropriate Atmospheric Monitoring Program.

The competent person shall prevent employees from working in excavations and trenches where there are hazards associated with water accumulation. The person shall also be responsible for monitoring the proper operation of water removal equipment.

The competent person shall ensure that employees are protected from falling equipment and previously excavated material by keeping such equipment or materials at least 2 feet back from the edge of the excavation.

The competent person shall ensure that walkways with a minimum width of 20 inches are provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with OSHA 29 CFR 1926.502 (b) shall be provided where walkways are 6 feet or more above lower levels.

Daily Inspections

The competent person shall perform daily inspections of excavations, the adjacent areas, and all protective systems for situations that could potentially result in slope failure.

Additionally, the competent person shall be aware of the potential for confined space situations and other hazardous work conditions.

The competent person shall inspect, evaluate, and complete the excavation checklist at the following intervals:

- Prior to the start of work, after each extended halt in work, and as needed throughout the shift as new sections of the excavation or trench are opened.
- After every rainstorm and other natural or man-made event that may increase the load on the walls of the excavation or otherwise affect their stability.

The competent person shall instruct employees to report any indications of potential slope failure.

The competent person shall stop the work and instruct all employees to leave the excavation or trench when any potential hazards are detected. The competent person has the authority to immediately suspend work if any unsafe condition is detected.

E. EMPLOYEE TRAINING

Employees who work in areas where shoring, sloping and benching, shielding, and other protective equipment are used shall receive initial training regarding the hazards associated with excavation and trenching operations.

Such employees shall receive refresher safety training whenever the following conditions apply:

- The hazards associated with their work environment change significantly.
- The supervisor has reason to believe that there are inadequacies in the person's knowledge of excavation and trenching operations.

Employees who work in excavations or trenches where there is a potential for hazardous atmospheres shall be trained to understand the nature of the hazard, to take necessary health and safety precautions, and to use the air quality controls and PPE.

Competent Person Training

Competent person training shall consist of formalized classroom instruction with examination and field exercises as permitted. A certificate of course completion indicating course title and names of trainee and instructor shall be issued in order to document successful course completion. Initially, a competent person assigned to excavation and trenching jobs shall be able to:

- Recognize and classify the basic soil types and understand their slope-holding characteristics.
- Select, recognize, and use different types of shoring, sloping and benching, shielding, and other types of protective equipment.
- Recognize confined space situations.
- Understand the basic hazards associated with excavation, trenching, and trenching operations.
- Recognize situations that could result in slope failure, and understand basic slope stabilizing methods.

- Perform atmospheric testing and monitoring.
- Complete excavation checklist.

A competent person shall receive additional training whenever the following conditions apply:

- There is a significant change in the job description or the type of equipment being used.
- There is a new hazard added to the work environment.
- The supervisor has reason to believe that there are inadequacies in the person's knowledge of excavation and trenching safety.

F. CHECKLISTS

- Safety Inspection Checklist for Excavations.

SAFETY INSPECTION CHECKLIST FOR EXCAVATIONS REFERENCED BY OSHA STANDARDS

This checklist is to be completed by the competent person at the start of work and as needed throughout the shift (i.e., after rain events, etc.). *(A competent person has been trained in the current OSHA excavation standard, is knowledgeable about soil analysis and protective systems, and has the authority to shut down the job.)*

Site Location: _____	Project #: _____
Date: _____ Time: _____	Competent Person: _____
Were visual soil tests made? If Yes, what type? _____	YES <input type="checkbox"/> NO <input type="checkbox"/> Type: _____
Were manual soil tests made? If yes, what type? _____	YES <input type="checkbox"/> NO <input type="checkbox"/> Type: _____
Soil Type: _____	Signature: _____
Soil Classification: _____	
Excavation Depth: _____	Excavation Width: _____
Protective System Used: _____	

In the following table, please place a Y for Yes, N for No, or N/A for Not Applicable in the right hand column for each item. If No, place the date of correction.

Subject		Y, N, or NA	Date Corrected
GENERAL INSPECTION OF THE JOB SITE			
1.	Does the competent person have the authority to remove employees from the excavation immediately?		
2.	Are surface obstructions removed or supported?		
3.	Are employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation?		
4.	Are hard hats worn by all employees?		
5.	Are excavated soil, materials, and equipment placed at least 2 feet from the edge of the excavation?		
6.	Are walkways and bridges over excavations 4 feet or more in depth equipped with standard guardrails and toe-boards?		
7.	Are warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic?		
8.	Are employees required to stand away from vehicles being loaded or unloaded?		
9.	Is a warning system established and used when mobile equipment operates near the edge of the excavation?		
10.	Are employees prohibited from going beneath suspended loads?		
11.	Are employees prohibited from working on the faces of sloped or benched excavations above other employees?		
UTILITIES			
12.	Were utility companies contacted and/or utilities located?		
13.	Are the exact locations of the utilities marked?		
14.	Are underground installations protected, supported, or removed when excavation is opened?		
MEANS OF ENTERING AND EXITING THE TRENCH			
15.	Is the distance along the trench to an exit no greater than 25 feet in excavations 4 feet or more in depth?		
16.	Is a support system, such as underpinning, being used?		
17.	Are ladders used in excavations secured and extended 3 feet above edge of the trench?		

	<i>Subject</i>	<i>Y, N, or NA</i>	<i>Date Corrected</i>
18.	Are structural ramps used by employees designed by a competent person?		
19.	Are structural ramps used for equipment designed by a registered professional engineer?		
20.	Are employees protected from cave-ins when entering or exiting the excavation?		
WET CONDITIONS			
21.	Is water removal equipment monitored by a competent person?		
22.	Is surface water or runoff diverted or controlled to prevent accumulation in the excavation?		
23.	Are inspections made after every rainstorm or other hazard-increasing occurrence?		
HAZARDOUS ATMOSPHERE			
24.	Is the atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficiency, combustible, or other harmful contaminant exposing employees to a hazard?		
25.	Are adequate precautions taken to protect employees from exposure to an atmosphere containing less than 19.5% oxygen and/or other hazardous atmospheres?		
26.	Is ventilation provided to prevent employee exposure to an atmosphere containing flammable gas 10% above the lower explosive limit of a gas?		
27.	Is testing conducted often to ensure that the atmosphere remains safe?		
28.	Is emergency equipment, such as breathing apparatus, safety harness and lifeline, and/or basket stretcher readily available where hazardous atmospheres could or do exist?		
SUPPORT SYSTEMS			
29.	Are materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads?		
30.	Are materials and equipment used for protective systems inspected and in good condition?		
31.	Are protective systems installed without exposing employees to the hazards of cave-ins (including end walls), collapses, or threat of being struck by materials or equipment?		
32.	Are excavations below the level of the base, or footing supported, approved by a registered professional engineer?		
33.	Does the removal of support systems progress from the bottom and members are released slowly? Note any indication of possible failure.		
34.	Is the excavation of material a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth?		
35.	Is there a shield system placed to prevent lateral movement?		